AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 3, No. 52. WEEKLY. | NEW YORK, DECEMBER 25, 1880. | $3.00 per Annum. SINGLE COPIES, 6 CENTS.

COPYRIGHT, 1880, BY AMERICAN MACHINIST PUBLISHING COMPANY.

Improved Woodworking Car Machinery.

The designing and building of machinery for constructing railroad cars has called forth some of the highest mechanical talent.

On this page we present two cuts of machines for car-building shops. The first is a power automatic knife grinder, which grinds either straight or concave. It is simple, substantial and easily taken care of; will sharpen planing knives of all kinds, long and short, giving a true bevel and a straight edge; or, if desired, will grind the bevel concave. The frame, as will be noticed, is of neat design, and is made in one solid casting of cored section and has a large floor base.

The wheel used is the cup form, as the knife is ground by it to a more accurate bevel, it will run lighter and can be replaced at small expense. The arbor runs in bearings upon the head plate, arranged to move forward as the wheel is reduced in size by wear.

By changing the stops on the edge of the platen, the carriage will traverse forward and back to suit the knife to be sharpened, which is clamped in a swinging frame adjustable to different angles.

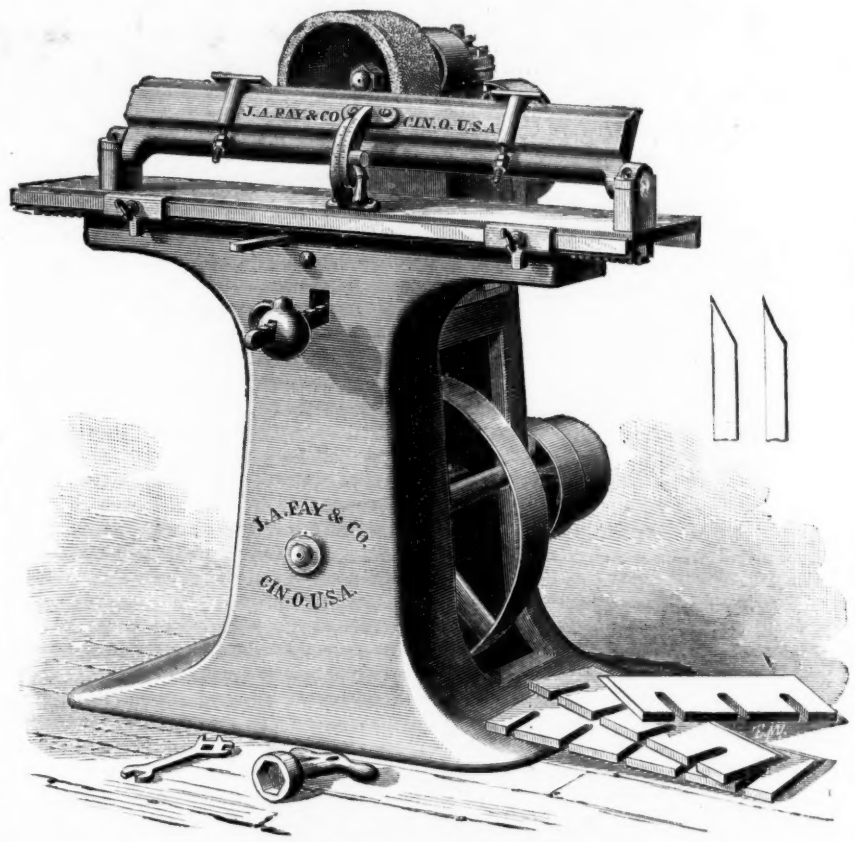
After being started, it will grind the knife to a proper edge and stop without further attention from the operator. It takes up less space than a grindstone and is much cleaner.

The second machine illustrated on this page is a large 6-roll, double drum Sand-Papering Machine, with expansive rolls and vibrating cylinder. It is designed to finish lumber to a perfect surface for painting or varnishing—takes stuff 24 inches wide, by four inches thick—has a powerful and continuous feed, consisting of six rollers in three pairs, driven by a strong train gearing, and arranged to expand to four inches in thickness. The feeding rollers in the upper frame, with the pressure rollers over the drums, are lifted together in a plane by the movement at once of four raising screws, operated by a chain and hand wheel. The lower feeding rollers are set in the lower frame, and remain always perfectly in line with the drums. The sand-paper drums are placed in the body of the machine, upon which the lower frame rests, and are driven in opposite or the same direction as may be necessary.

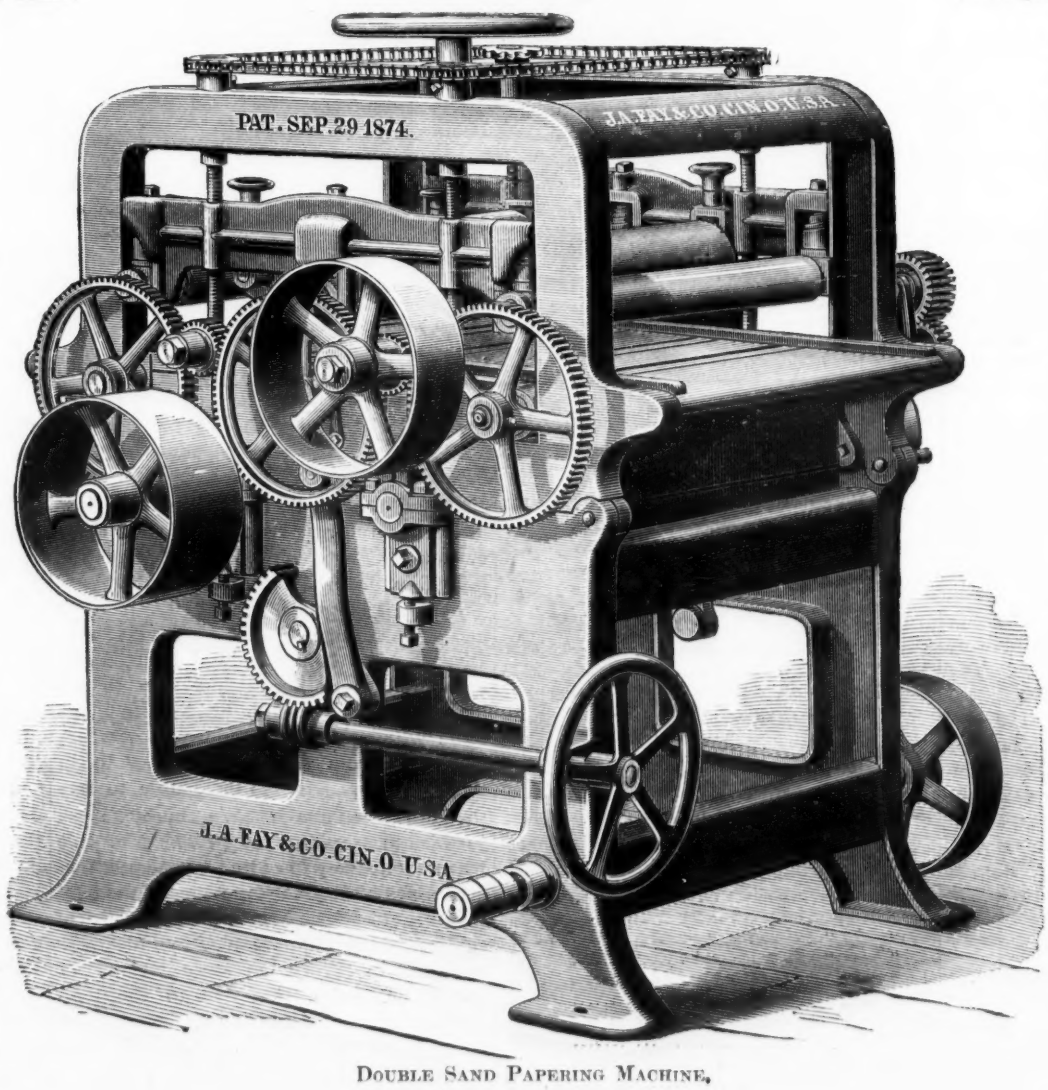
The finishing drum has a vibratory lateral motion, to remove continuous lines from any inequalities in the sand paper. The lower frame is hinged at each end, so that by removing a pin either drum end may be reached by raising the frame with the screw and worm gear, operated by a hand wheel at the end of the machine.

These two machines are made at the extensive works of J. A. Fay & Co., Cincinnati, O.

They are in successful use in quite a number of car shops and planing mills, greatly facilitating fine and accurate work, therefore materially cheapening the cost of production.



AUTOMATIC KNIFE GRINDING MACHINE.



DOUBLE SAND PAPERING MACHINE.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * In my last letter to you I broached the subject of convenient details of machines, and immediately branched off into a sort of description of an old lathe which didn't have any conveniences, except an apron cup to hold chalk. Perhaps the digression was not unprofitable after all, as it related to the common error of paying out six days' wages for four days' production, when the shortage is a matter entirely beyond the control of the man who receives the wages.

* * * * A quarter of an inch increase in the width of beltage, on a lathe or other tool, will often increase its production ten per cent. A two dollar man will, on the improved machine, give twenty cents worth of extra work every day for nothing. This for a year is $60 actually gained by putting the increasd capacity into the lathe. Sixty dollars is six per cent. on a thousand dollars—a sum which will buy a very respectable sort of a lathe.

I do not believe there can be a bargain in a cheap machine if the cheapness comes from a defect in the capacity of the machine. This applies, in every case, where the running of the machine calls for wages, and where there is steady work for the machine.

* * * * Many modern lathes, claimed to be of first-class make, have no arrangement for raising and lowering the tool. In very large lathes, the tool, of course, does not need accurate setting; but in lathes, say, under 30″ swing, which do lots of boring, and which often work on jobs of very small diameter, the height of the tool requires close attention, and the time spent in blocking up tools with scrap iron will pay for an adjustable outfit every sixty days.

The lathe buyer will not generally consider the value of such a rig, and the tool builder soon finds that by leaving it off and lowering his price, he can sell more readily and get just as much credit for being first-class. After a while the maker becomes sodden, made so by the lack of appreciation on the part of customers, and forgets that there is any good way of adjusting lathe tools; says a tool isn't solid when it has an elevating trap under it. He knows, or ought to know well enough, that a good elevating tool rest can be made as solid and effective as any other part of a lathe.

* * * * The stop screw on a slide rest is a real valuable institution.

In screw cutting it allows the tool to be moved in boldly, with the consciousness that it will only take such a depth of cut as has to be defined for it by the adjustment of the stop screw during the back trip. I expect a stop of this kind adds about two dollars to the cost of a lathe.

* * * * I once worked on a

36" lathe, and a good one too, in which the feed was by screw compound gear. It was in a country shop doing all kinds of work, and I calculated that I spent one-sixth of my time at the head of that lathe changing the gears from feed to screw cutting, and from screw cutting to feed.

Four greasy feed gears to take off and three ditto screw gears to put on; then three screw gears to take off and four feed gears to put on. Ever since that experience I have determined that if I ever bought a compound geared screw-feed lathe, for general shop work, it would be at a discount of not less than ninety per cent. from the price of a lathe having a feed somewhat independent of the screw-cutting mechanism.

* * * * Why can't lathe builders make some decent provision for the storage of change gears? The head leg presents a surface which could be easily adapted to hold pegs, on which the gears could be hung. Instead of that simple contrivance a man finds, when he buys a new lathe, that he must cobble up a wooden rig to attach to the lathe as a gear board, or else they must be hung on the nearest piece of wall, maybe twenty feet from the lathe. A cupboard to lay gears in is the biggest kind of a fraud. It is not as clean and tidy as piling the gears on the floor. Question: How much extra could a maker get for a lathe because it had some provision made for hanging change gears?

* * * * Sometimes talent in design is wasted, even when the result of the talent don't interfere with the sale of a thing. One extreme case came within my knowledge lately. Bennett builds lathes with cone gearing, having an "in-and-out" pin for changing the feed from slow to quick by a simple knob movement. This is for use in taking the modern sliding cut. The knob of the "in-and-out" pin is a conspicuous projection from the first gear spindle. The effect of the pin, when pulled out, is to double the speed of the carriage movement, whether in screw cutting or simple feeding. As a consequence, a single pair of gears will cut a certain thread when the pin is in, and a thread of twice that pitch when the pin is out. The screw-cutting table, a big piece of brass on the head of the lathe, showed what threads could be cut when the pin was "in" and when "out." A party had one of these lathes for eight months and then sent to Bennett for a proper gear to cut five threads to the inch. He wrote that the list on the lathe said so-and-so, but that the gears given would produce ten to the inch, and, at the same time, inquired what "in-and-out" on the list meant.

This lathe had been running in a shop owned by three partners, all machinists, and had probably been run by half a dozen workmen, and still no one had "tumbled" to the simple mystery of an "in-and-out" pin.

* * * * When still an apprentice, I was chief actor in a case fully as bad as the one just cited.

A new lathe, twenty-four-inch swing, came from New Haven, and I was put in charge of it. I got it in shape, and inspected every detail, whether novel or not. I ran the tail spindle clear out and noticed that there was no hole by which to drift the center out. Such was the only plan I knew of. I called the foreman's attention to the oversight, blackguarded the makers for the blunder, and asked if I should drill the hole. The foreman said "Yes," but smilingly suggested that I postpone it a few days.

After a day's experience with the lathe, I found that the tail center had a tendency to get loose once in a while. I investigated, and discovered the well-known plan of expelling the center by means of the screw. My brilliant mind had not been capable of rising to the level of this simple little contrivance.

* * * * Very respectfully,

CHORDAL.

Denver (Col.) capitalists have subscribed $1,000,000 to build a narrow-gauge railroad, starting from the center of the city and completely encircling its suburbs.

Navy Yard Tests of the Anthracite.

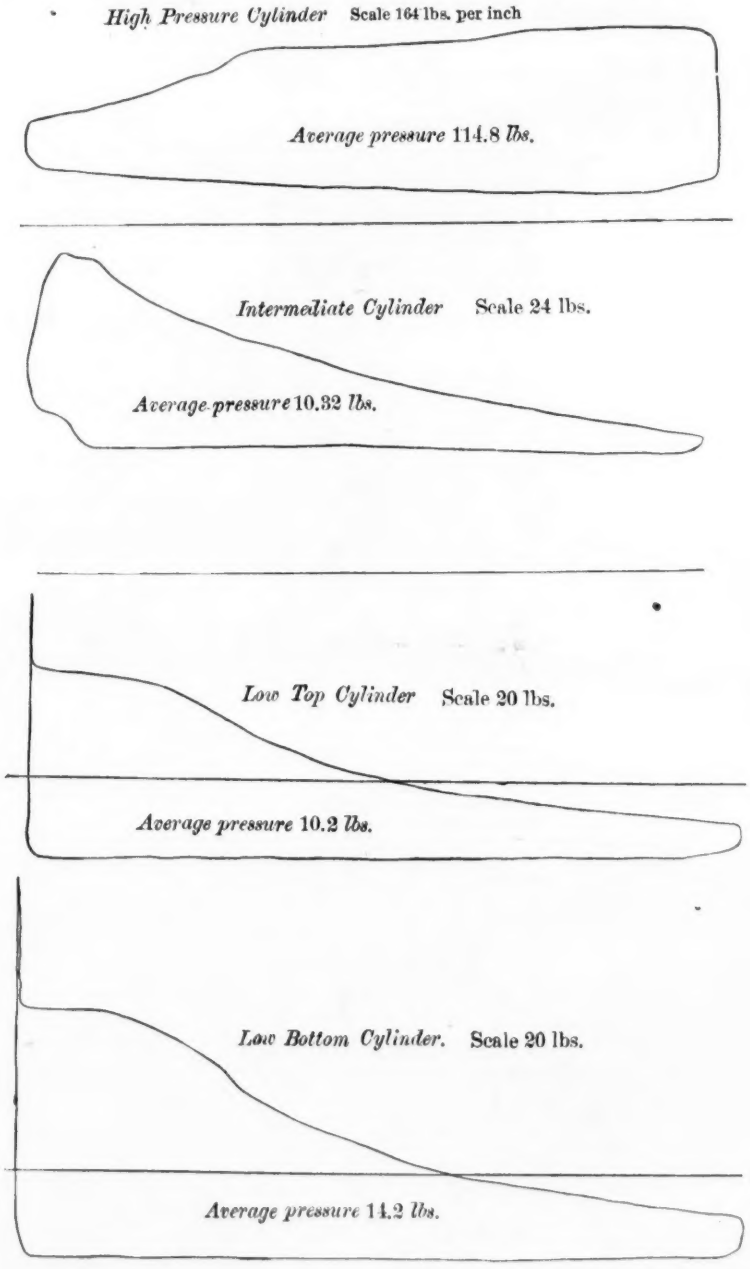
The set of diagrams shown herewith were taken during the experiments in the Brooklyn Navy Yard. The boiler pressure was 350 pounds at the time of taking the card from the high-pressure cylinder, but this pressure fluctuated somewhat by the time the last card of the set was taken. The revolutions per minute were 103, while the revolutions per minute during Mr. Bramwell's experiment were 131.

The following extracts from the tables contain quantitative results obtained during the trial:

Duration of experiment in hours and minutes	23 58
Total quantity of Cumberland semi-bituminous coal consumed, in pounds	4,400
Total pounds of refuse in ash and clinker.	776
Total pounds of combustible consumed	3,624
Total pounds of feed water pumped into the boiler	35,114
Total double strokes of the pistons.	148,154
Steam pressure in the boiler, in pounds, above the atmosphere.	316.50
Steam pressure in the receiver, in pounds, above the atmosphere	10.54
Throttle wide open (In none of the cylinders was the steam cushioned, nor was there steam or exhaust lead.)	
Vacuum in condenser, in inches, of mercury	26.75
Back pressure in condenser, in pounds, above zero	1.6066
Temperature, in degrees, Fahr., of feed water	130.5
Temperature, in degrees, of steam in the boiler, saturated	430.0
Pounds of coal consumed, per hour	183.5883
Pounds of coal consumed, per hour, per square foot of grate	11.9867
Mean back pressure against the piston of 3rd cylinder, in pounds	4.21
Indicated H.P. of 1st cylinder	30.4308
" " 2nd "	7.8990
" " 3rd "	39.4483
Aggregate indicated H.P. for all 3 cylinders	67.7081
Total H. P. developed in 3 cylinders	80.1525
Pounds of coal consumed, per hour, per indicated H.P.	2.7115
Pounds of feed water consumed, per hour, per indicated H.P.	21,63875
Pounds of steam condensed in the 1st, 2nd, and 3rd cylinders, to furnish the heat transmitted into the total H.P. developed in those cylinders, by the expanded steam alone	167.0720
Pounds of water vaporized from 212° by one pound of coal	9.2671

"There were additionally certain peculiarities of performance observed, which are worthy of notice, and essential to a complete understanding of the action of the machinery. An inspection of the indicator diagrams shows a large difference between the boiler pressure and that of the high-pressure cylinder.

The throttle valve was carried "full open," and the restriction in the steam pipe to produce this result, whether of original design or a temporary expedient, was beyond the knowledge of the Board. The temperature of the steam at the throttle valve, close to the valve chest of the high-pressure cylinder, was ascertained by a high-grade thermometer immersed in a cup of oil extending into the steam space of the throttle-valve chest, but not exactly in the line of the flow of steam. In every trial it indicated three or four degrees more of heat than was normal to the boiler pressure at the time; although it is probable, from its position and surroundings, that the readings were somewhat less than the absolute temperature of the passing steam. In taking diagrams from the high pressure and medium cylinders, much annoyance was experienced from the presence of water in those cylinders. It was impossible to free the indicators from it. We think we are justified in ascribing the presence of this water exclusively to cylinder condensation, arising from the great difference of the temperatures to which the interior cylindrical surface of the high-pressure cylinder was exposed at every alternate stroke of its piston, being that due to the temperature of the entering steam and that of the steam in the receiver. This difference averaged, during the trial, 117½ degrees Fah., the effects of which, in producing condensations, the moderate superheating and the insufficient jacketing could but little reduce. The table, shows, as we believe, the amount of this condensation in the high-pressure cylinder. The tightness of the pistons, the thorough system of checks on the record and observations, the dryness of the steam as shown by its high temperature in the steam pipe assure us that neither leakage, priming or imperfect records had much influence in producing the difference between the quantity of steam in the cylinder, as shown by the indicator, and the quantity evaporated, as shown by tank measurement.


High Pressure Cylinder Scale 164 lbs. per inch
Average pressure 114.8 lbs.
Intermediate Cylinder Scale 24 lbs.
Average pressure 10.32 lbs.
Low Top Cylinder Scale 20 lbs.
Average pressure 10.2 lbs.
Low Bottom Cylinder. Scale 20 lbs.
Average pressure 14.2 lbs.

Small rings of tin, lead and zinc were suspended in the interior of the boiler casing above all the tubes. The tin and lead were melted, the zinc was not. The temperature of the gases escaping from the boiler must, therefore, have been between 600 degrees and 740 degrees Fah.

One of the most pleasing facts observed during the experiment was the perfectly satisfactory manner in which the piston packings and the steam valves of the low-pressure cylinder worked without lubrication.

No provision is made for the introduction of lubricants within the cylinders, nor has any ever been used, and, as a consequence, the water in the last tank filled from the hot well was as pure and transparent as that from the hydrant. The cylinders, when opened, were in excellent condition.

Comparing the results of the above trial with those obtained in England from a trial made by Mr. Bramwell, with the vessel in free route, we find so great a discrepancy that we deem it proper to submit, with our report, the following statements and calculations, which explain the causes that might have produced the difference. Before proceeding to this, it was necessary to obtain the results of Mr. Bramwell's experiment in greater detail than given in his report, and we have consequently calculated from the indicator diagrams appended to it, and from the drawings of the engines furnished us by Major George Deane, the quantities contained in the following table (not here shown), and necessary for our comparison. The table contains much data and results from the experiment made in England by Mr. Bramwell on the machinery of the "Anthracite" with the vessel in free route, as are necessary to reconcile the differences in the economic performance of the machinery during that experiment and during ours:

A cursory glance at the cost of the indicated horse power in pounds of coal consumed per hour during the two experiments shows the wide difference between 2.7115 pounds in our experiments and 1.7114 pounds in Mr. Bramwell's; or, that the economic results in the latter were:

$$\frac{2.7115-1.7114\times100}{2.7115}=36.88 \text{ per centum}$$

superior to those in the former. This great difference, however, is only found when the crude coal is employed as the measure of the cost, and it includes not only the difference due to the condition of the steam in the two experiments, but the difference in the evaporative power of the coals.

The two coals had very different percentages of refuse; the Nixon navigation coal used in Mr. Bramwell's experiment having 5 per centum of loose white ash, without clinker, while the Cumberland semi-bituminous coal, used in our experiment, had 17.6363 per centum of refuse, with a large portion of clinker.

When the comparison is made for the combustible portion of the coal, that is for the normal of what remains after deduction of the refuse, the economic results of the two experiments compare as 2.2333 pounds of combustible consumed per hour per indicated horse power in our experiment to 1.6259 pounds in Mr. Bramwell's experiment. But the latter requires a correction for the injurious effect of keeping open the furnace door to break up the clinker from the grate and withdraw it through the furnace door. Whenever the furnace door is

opened the boiler is cooled by the in-rushing mass of cold air, and it was found during several experiments made in 1878, on the "Murphy shaking grate bar," that the combustible portion of coal experiences a loss of vaporizative effect of 0.3935 per centum for every one per centum of the crude coal contained in refuse, removed through the furnace door. According to this the combustible portion of the coal consumed during an experiment should be reduced—

$17.6363 \times 0.3935 = 6.9399$ per centum relatively to the coal consumed in Mr. Bramwell's experiment, on which no such reduction is to be made. Making this reduction for the coal used in our experiment, the above 1.6259 pounds become—

100.0000 : 1.6259 : : 100.0000—6.9399 : 2.0783, so that by the coal measure the economic result for the indicated power was

$$\frac{2.0783 - 1.6259 \times 100}{2.0783} = 21.77 \text{ per centum}$$

greater in Mr. Bramwell's experiment, than in ours. If the comparison be made for the units of heat consumed per total horse power, the units will be as follows: In Mr. Bramwell's experiment, the total horse power was obtained for an expenditure of 16719.1503 Fah. units of heat per hour, and in our experiment it was obtained similarly for 20498.22 units, or the economic result in Mr. Bramwell's experiment was

$$\frac{20498.22 - 16719.15 \times 100}{20498\ 22} = 18.35 \text{ per centum}$$

superior to the economic result in ours. This percentage is the true difference in the two experiments. The only manner in which this large difference can be accounted for is by supposing that in Mr. Bramwell's experiment the water level in the boiler was carried lower than in ours, and that the boiler steam was consequently more superheated. It is known that, when in the Anthracite's boiler, the water level fell below a certain point, the steam became superheated to the degree of burning the packings in the stuffing boxes of the valve stems. In our experiment, the water was kept well above this level. Moreover, the difference between the boiler pressure and the initial pressure in the first cylinder was much greater during Mr. Bramwell's experiment than in ours, whereby the corresponding differences of temperature were greater in his. The differences of these temperatures in Mr. Bramwell's experiment was 45 degrees Fah., and in ours 35 degrees, in which it follows that the super-heating from this cause was greater in his experiment than in ours. This was owing to the greater throttling in his experiment. Further: the speed of the pistons was greater in his experiment than in ours; and when the pressures on the pistons are sensibly the same, as in the case of these experiments, this causes a decrease in some unknown ratio of the cylinder condensations. In Mr. Bramwell's experiment, the pistons made 130.3881 double strokes per minute, and in ours 103.02782 double strokes. The difference, as the piston pressures were nearly equal, was caused by the fact that Mr. Bramwell's experiment was made with the vessel in free route, while in ours the vessel was secured to the wharf.

The belief that the steam was considerably more super-heated in Mr. Bramwell's experiment than in ours is sustained by a comparison of the cylinder condensations in the two cases. In our experiment, the steam condensed in the first cylinder was 56.22 per centum of the total quantity evaporated in the boiler. In his experiment it was 34.99 per centum.

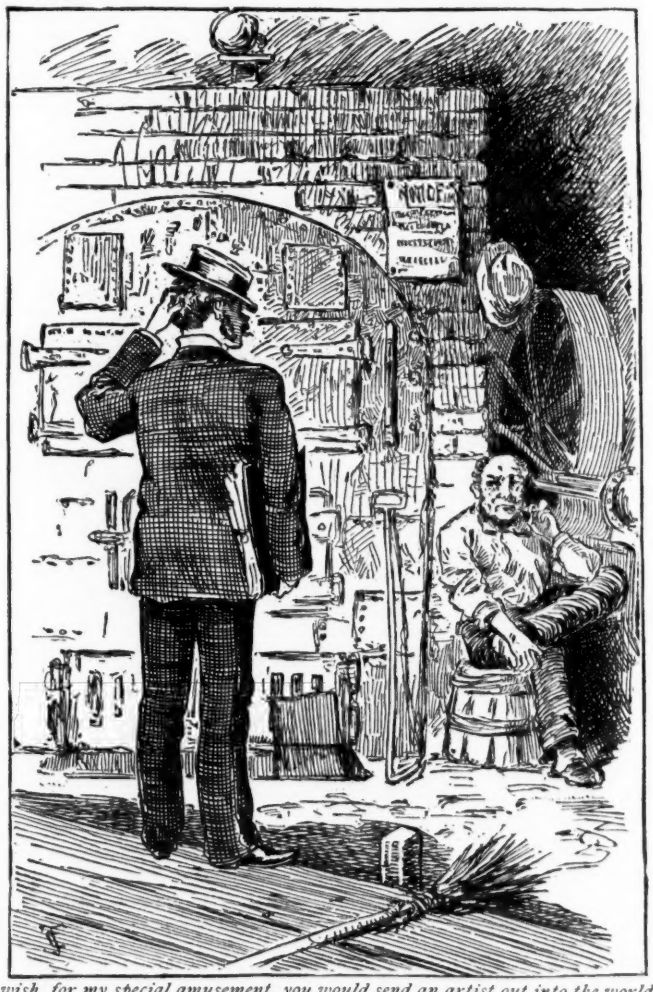
In our experiment, the steam condensed in the second cylinder was 38.41 per centum of the total quantity evaporated in the boiler. In his experiment it was 21.53 per centum.

In our experiment, the steam considered in the third cylinder was 10.05 per centum of the total quantity evaporated in the boiler. In his experiment, it was 8.47 per centum. The following investigation will show whether these differences in the cylinder condensations, in the two experiments, will account for the difference in the heat cost of the powers respectively developed. In the first cylinder, during our experiment, there were utilized of the total weight of steam evaporated in the boiler, 100.00—56.22 =43.78 per centum, but if the cylinder condensation had been the same as during Mr. Bramwell's experiment, the percentage utilized would have been 100.00—34.99= 65.01, so that the total horse power developed in that cylinder during our experiment, instead of being 28.8902, would have been:

$$\frac{28.8902 \times 65.01}{43.78} = 42.9000.$$

In the second cylinder, during our experiment, there were utilized of the total weight of steam evaporated in the boiler 100.00—38.41=61.59 per centum, but if the cylinder condensation had been the same as during Mr. Bramwell's experiment, the percentage utilized would have been 100.00—21.53= 78.47 per centum, so that the total horse power developed in that cylinder during our experiment, instead of being 23.2490, would have been:

$$\frac{23.2490 \times 78.49}{61.59} = 30.8949.$$



I wish, for my special amusement, you would send an artist out into the world with instructions to bring back a good sketch of a common boiler front.—Page 299.

ILLUSTRATION FROM "EXTRACTS FROM CHORDAL'S LETTERS."

In the third cylinder, during our experiment, there were utilized of the total weight of steam evaporated in the boiler 100.00—10.05=89.95 per centum, but if the cylinder condensation had been the same as during Mr. Bramwell's experiment, the percentage would have been 100.00—8.47=91.53, so that the total horse power developed in that cylinder during our experiment, instead of being 28.0133, would have been:

$$\frac{28.0133 \times 91.53}{89.95} = 28.5054.$$

The sum of the above new total horse power is $42.9000 + 30.8949 + 28.5054 = 102.3003$, which is what the engine would have developed during our experiment with the weight of steam then evaporated in the boiler, had the cylinder condensation been the same as in Mr. Bramwell's experiment. Dividing the weight of steam evaporated in the boiler during our experiment, by the new total horse power, there results for the cost of the total horse power:

$$\frac{1465.11822}{102,3003} = 14.3217 \text{ pounds of feed water}$$

per hour, equivalent to $14.3217 \times 1121.4 = 16060.3992$ Fahr. units of heat. In Mr. Bramwell's experiment the total horse power cost 14.8893 pounds of feed water per hour, equivalent to 16719.1403 Fahr. units of heat, the discrepancy being about four per centum of the greater quantity, a very close approximation, as it includes all errors of observation and calculation. It is, therefore, clear that the difference in the cost of the power during the two experiments, was wholly due to, and measured by, the difference in the cylinder condensations.

Known and Unknown Facts About Belting.

BY A. B. COUCH.

An engine or a water wheel is to deliver a known amount of power through a belt. Its velocity being given, what should be its width?

An elevator, a pump, a Daniels planer, or a brick machine is to be driven by a belt under given conditions. Required, in each case, the necessary and sufficient width of belt.

The numerous interesting articles on belting in the columns of the AMERICAN MACHINIST, within the past few months, have been rather comparative than positive in scope, and have seemed to stop short of the main point. The inquirer may know whether a six-inch belt will do any more work than a three-inch one, and if not, why not? He may be familiar with atmospheric pressure, appreciate the similarity of belts to surface plates, or even have in his mind's eye a luminous view of a belt running on a pulley of infinite radius; but all these will aid him very little in finding out the one thing he wants to know, viz, the suitable width of belt for each case.

When the actual force to be transmitted is known with tolerable correctness, the question becomes one of pounds per inch in width.

Rules laid down by some engineers make the *diameter of the smallest pulley* a direct factor of the force which should be transmitted. Others, based on somewhat similar views, make the *length of belt in contact with the pulley* such a factor—thus: Let an open belt run upon two pulleys, each two feet in diameter. Let a similar belt run upon two pulleys, each four feet in diameter. Then, by either of these rules, the latter belt should transmit twice as great a force as the former. Facts are entirely at variance with such a conclusion.

Others make the force transmitted directly *as the arc of contact*, or proportion of the circumference of the pulley enveloped by the belt. These recognize the fact that the angular extent of the contact determines the adhesion, and thus far, tend in the right direction.

Three forces are principally concerned in transmission by a belt:

First, its tension on the driving side.

Second, its tension on the slack side.

Third, its adhesion to the pulleys.

The difference between the first and second is the net force transmitted, and cannot exceed the third.

It is necessary first to inquire what tension can be continuously applied to the driving side without injury. The question will then stand: What other, and less, tension applied to the slack side will produce an adhesion at least equal to the difference between the two tensions?

The subject has been investigated mathematically by Rankine, and experimentally by Morin and others. A paper contributed to the *Journal of the Franklin Institute* of January, 1868, by Mr. Robert Briggs, gives the result of some investigations made by himself and Mr. H. R. Towne, and is of great practical interest. The same paper is also published in Mr. J. H. Cooper's "Use of Belting."

The greater or driving tension was taken at about 67 lbs. per inch wide, or one-third of the ascertained breaking strength of the laced joinings of single leather belts, and the co-efficient of useful friction at six-tenths of that established for sliding friction, by their own experiments as well as those of Morin. It was found that, with equal arcs of contact, the adhesion did not materially differ on pulleys of 12, 24 or 42 inches diameter. Their experiments, as well as a number of practical examples cited, confirm their theoretical conclusions. The results are summarized in the following table, which gives, for arcs of contact from one-quarter to three-quarters of the circumference, the net force which should be transmitted for each inch in width of single leather belt.

Arc of contact.	*Lbs. per inch.*	*Arc of contact.*	*Lbs. per inch.*
90°	32.33	150°	44.64
100°	34.80	180°	49.01
110°	37.07	210°	52.52
120°	39.18	240°	55.33
135°	42.06	270°	57.58

This coincides well with what has been considered good practice by many, who have relied on a force of about 50 lbs. per inch with a contact of 180°, increasing or diminishing with the arc, but more from judgment than any definite calculation.

For convenience of memory these results may be approximated by the use of this simple rule:

To one-seventh of the number of degrees of contact add 21. The result is the force in pounds per inch wide, which should be transmitted.

The single leather belt, laced, is in such general use that its strength must be taken as the basis in the arrangement of general machinery. Mr. Towne found the strength of riveted belts to be about 80 per cent. greater. A few have been known to last a long time, under tensions twice as great as those indicated by the above table. But tensions one-third greater than those of the table are about as high as can be applied to single riveted belts of average quality, without unequal stretching and consequent loss of durability.

There is a lack of reliable information as to belt transmission with small pulleys and at high speeds, beyond the fact that the centrifugal force and imperfect flexibility cause loss of adhesion. Any systematic expression of the quantity of loss would hardly be possible, but some careful and intelligent experiments in that direction would be valuable.

Jewelers' Impression Mill.

The bent of the American mind to replace hand by machine labor finds a striking example in our methods of manufacturing jewelry.

The tools which the trade brought from Europe were few in number and ill-adapted for a systematic and a large product, being rough, weak, and slow, and the rapid advance made recently in this trade is due, in a large measure, to powerful and carefully designed machinery.

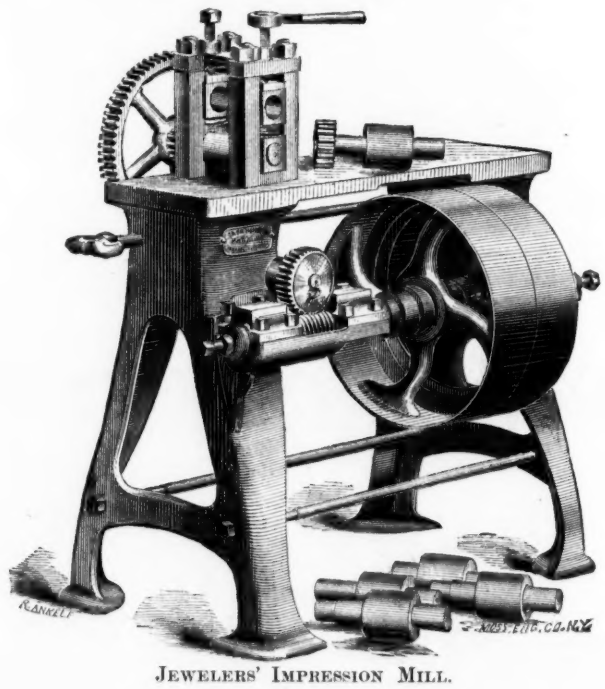
In the cut herewith we illustrate an Impression Mill, in which there are a few novel features. It consists of a pair of rolls (3″x3″), the top one engraved, which are contained in housings on a table, and driven by gearing.

The pattern on the upper roll is impressed into the metal as it passes through. The general arrangement explains itself. On the table is shown the engraved top roll about to be put into the stands, while the extra rolls for the various patterns are shown on the floor.

The housings and the use of the worm gear are novelties for this kind of tool. Four bars, square in section, form the uprights. Threads are cut on the ends of the bars. One end passing through the table is held by a large nut, while the wrought iron cap —one solid forging—is dropped over the other. This arrangement, while much neater than the usual large, ungainly cast-iron housings, secures an advantage in the facility with which the rolls can be changed. The worm or driving shaft is carried in three long bearings. The thrust from the screw is taken by set screws, which are stepped into the case-hardened ends of the shaft. A fly wheel, 16″ diameter by 4″ face, forms the tight pulley. The worm of hardened Krupp steel turns in an oil bath. By using a case-hardened worm wheel with this worm, thrust screws and abundant lubrication, the objection to worm gearing would seem to be overcome, while the advantages of strong gearing, 50 to 1, and steady, noiseless motion are secured.

All the pinions are of case-hardened wrought iron. The table, housings, cap, and gears are highly finished and polished to harmonize with the metal which the machine works, and a certain amount of attention seems to have been paid to secure graceful outlines, combined with strength and rigidity.

This machine is made by G. A. Ohl & Co., East Newark, N. J.



JEWELERS' IMPRESSION MILL.

Letters From Practical Men.

BODMER AND WHITWORTH.

Editor American Machinist:

I was much interested in your article on measuring machines in which the above inventors are mentioned. Bodmer was born in 1786 in Switzerland, and died in 1864; Whitworth was born in 1803, and is still living. So they have both had a long lease of life. It would seem that intense study and an inventive brain did not shorten life, for no two mechanical engineers, or mechanicians, have produced more improvements or approached nearer perfection. Bodmer was a strange-tempered man, but extremely clever; he had a head that could invent anything. He was excessively careful of his tools, and had boards to cover the lathe shears, and would not allow a man to lay a wrench or a tool on them. The consequence was that after many years' use, when he dissolved with Birley, the tools sold for above their value when new. Everything about the shops was conducted with order, cleanliness and system—no lack of grindstones, and all kept perfectly true, with an iron rest in front, and the stone covered with a sheet-iron case. It is nothing unusual out West to see a Dutch Hoosier holding a lathe or planing-machine tool loose in his fingers on the top of the stone. Sometimes the stone runs the wrong way, up against the wall, and often it is not round within an inch and a half. The kind of miserable clawing and cordu-roy work tools ground in that way produce can be easier imagined than described.

Bodmer's system of working, and the care that a turner had to take of his lathe, was the reverse of modern practice in many Western jobbing shops. It is nothing unusual here for a rushing workman, when put on a new lathe, to run into his chuck with a tool, break his screw-cutting gear, smash his face plates, break his bolts, lay rough castings, sledges, tools and hammers on the naked lathe bed, and make a scrap heap of the whole machine. Old Bodmer used to go round and try his templates in every hole, and if they did not fit perfectly he would up with the hammer and smash the work, send for his foreman and raise the very mischief. There was a kind of rivalry between Bodmer and Whitworth as to which would do the most perfect work. There was no stinting of metal in their work. Everything was made as stiff and powerful as possible. There are plenty of their tools running now in good order that were made over forty years since. They were the first to bring out improved machinery for grinding case-hardened wrought iron and hardened steel, *dead true*, and I believe the first to introduce conical lathe spindles. They did away with brass boxes, and substituted steel bushes.

Sellers, of Philadelphia, had some massive and expensive machine tools at the Austrian Exhibition, some years ago, that were spoken of very highly by the English tool builders. But a man, evidently an advocate of the cheap, light, handy, fancy style, wrote to a New York paper: "What is the use of making work like that, to wear forever, when it will probably be superseded in ten years?"

Miserable argument! No machine-shop tools can be made too well nor to wear too long. There is no kind of trashy work done but will have its defenders.

I recollect looking at an old coffee mill of a lathe, 18 inches from the center, with the fast-head stock constructed so that it had a cone and gear equal to a twelve-inch head, with a weight to keep down the carriage which slid on two little narrow V's. The feed was worked by a little round belt on pulleys with three grooves, the coarsest of which produced work, with a pointed tool, that you could scarcely see with the naked eye. I remarked to the foreman that his lathe was hardly up to the times, and he replied: "That is the best way to make a lathe, because when the carriage is gibbed down it wears the shears."

When I went to the trade in Manchester, in 1842, scraping, instead of grinding gauges to standard sizes, and steel mandrels, with hardened ends, were in use then, and had been for years before. Fifteen years afterwards, I worked in a machine shop in western New York, where there was not a surface plate in the shop. The pistons and valves were all ground with oil and emery. No standard gauges; no steel mandrels; the mandrels were all made of iron, and turned down a size smaller every time, so that sometimes one end would be four inches, and the other two, and always swelled and battered so as to never run true.

Is it surprising that a shop conducted on such a slovenly, unsystematic, outrageous, dirt-and-disorder principle, should collapse? The trouble seems to be there are a great many capitalists engaged in the business which they do not understand, having had no mechanical training; they are in business *so'e'y to make money*; they get a manager who may be a good engineer on paper, but who knows little or nothing about mechanical tools, and he in turn picks a boy out of the shop, who knows less and has never been anywhere else, for his foreman.

Sir Joseph Whitworth began as an apprentice, and worked as a journeyman for years; he has made it the aim of his life to make work that nobody could make any better, regardless of time or expense. He is now a hale old man of seventy-seven, wealthy and famous, while many grinding, driving, shoddy manufacturers have made large fortunes, and died as unknowing as they were unknown.

Respectfully yours,

VETERAN.

Fort Wayne, Ind.

THE BELTING QUESTION.

Editor American Machinist:

It will probably have struck your readers as singular that in all the answers to my remarks on belting, not one has attempted any explanation of the acknowledged fact that the driving power of a belt varies with the nature of the surfaces in contact, and that the driving power increases with the smoothness and truth of the pulley surface, as well as with the bedding of the belt surface, since these facts are the ones put forth by me as evidence that the area of contact influences the driving power.

I am not a little disappointed at this omission. I am aware that these elements, important as they are, are so variable in any given belt and pulleys as to make it almost, if not quite impossible, to assign them a certain degree of perfection, and a corresponding value, yet I think that their bearing upon the question, as to whether they do not prove the area of contact to be an important element in calculating the driving power of a belt, demands solution, if such be possible. With these thoughts in mind, I am led to ask your correspondents as follows:

First.—Is there more area of contact between the belt and pulley surfaces when the pulley is true and smooth, and the belt surface pliable and level, than when such is not the case?

Second.—Is the driving power of a belt increased when the area of contact is increased, by reason of greater pulley truth and smoothness, and the belt "hugs" closer?

Third.—Is not this increase of driving power due to the increase of contact area, and if not, to what is it due?

Fourth.—Does not a belt, grain side to pulley, drive more than it does flesh side to pulley, and to what other cause than increased area of contact is this due?

Fifth.—Do you know of any rule that assumes a given or stated degree of smoothness for a pulley, and assigns any value to it?

Sixth.—In giving the coefficient of friction for leather belting, is the same value assigned for the grain side as for the flesh side of the leather? If so, how do the laws of friction account for the different value? If not, are those laws applicable to the case?

Mr. Bilgram retorts in kind by asking me some questions. Now the fact is I am not prepared to lay down any cast-iron rules for belting, and my position is that such rules cannot be laid down, because practice demonstrates that there is much in the question that is not at present accounted for. It is very easy to accept a certain coefficient of friction, as that for leather sliding on iron, and to then say, add as much per cent. if the grain side of the leather is next to the iron.

This is simply saying so-and-so is the law, and then adding an *aside* that as the facts sometimes don't agree with the law, he will maintain the law, anyhow, and say, like the Frenchman, "*so much the worse for the facts, the law must stand.*" In addition to this, we have the fact that when it comes to practice we are told to increase the coefficient given by this cast-iron law for one side of the leather, but not for the other, while the law furnishes no reason for the addition.

But let me answer Mr. Bilgram's questions:

"A 2″ belt is running on a 12″ pulley, tension 200 pounds, transmitting at a certain speed ¼ horse power."

First.—Will the same belt, with the tension increased to 400 pounds, be capable of transmitting double the power?

Answer.—No. Suppose the weight of the belt on the driving side of the pulley to be 50 pounds, then added to its 200 pounds of tension we have 250 pounds as the pressure on the pulley in the one case. Now, if we add the belt weight (on the driving side), 50 pounds, to the four hundred pounds in the other case, we have 450 pounds; and 450 pounds is not equal to twice 250 pounds.

Second.—"How much power will be transmitted by a 4″ belt of 400 pounds tension when running at the same speed and over the same pulleys?"

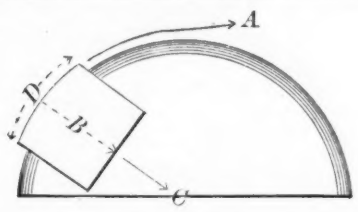
Answer. Here is an example of the *cast iron* rules, and my answer is just this: Nobody knows; because the smoothness of the pulleys is left out; the bedding of the belt to the pulley is left out, whether the belt is grain or flesh side to pulley is left out, and all agree that these are important factors, making some 25 or 30 per cent. difference in the driving power.

Third. "Is not a 4″ belt at 400 pounds tension equal to two 2″ belts at 200 pounds tension each?"

Answer. It should be if all the elements were equal; but this is not the case in practice, because of the difference in the pulley smoothness, bedding of belt, the same as in the second answer.

Now, if any data were at hand determining, within any certain limits, what difference the varying degrees of smoothness found in pulleys, as usually offered commercially (and there is great difference in this respect), makes in the driving power; and from this data a mean or average condition was assumed, the resulting coefficient would be all right as being as near as it is practicable to attain, and this would take the *cast iron* nature out of the rule, though still leaving it applicable as a rule.

To those of your correspondents who have replied on the arc question, that increasing the arc increases the pressure of the belt on the pulley, I would reply that in my spherical pulley the arcs varied while the pressure remained the same; hence these demonstrations do not reach the case. To my mind that proposition is unanswerable, hence I hope you will republish the cut, and I again refer to it as follows: A piece of leather *B*,



is pressed to a spherical pulley (capable, let us say, of rotating in any direction), with a pressure of 1 pound per square inch. The length *B*, is twice the width *D*. A power uniform all along the edge is applied to pull the belt in the direction of *A*, and then to pull it in the direction of *C*. Will not the power required to move it be the same in both cases? This is a simple and fair question.

Assuming that it will be, it proves that the arc of contact, simply as an arc of contact fhat is increased as an arc, but not increased in gross pressure to the pulley, is not an element to be considered.

Let us now assume the length *B*, of the piece to be 10″ its width, *D* to be 5″. Now suppose this piece of leather to be part of a belt running in the direction of *A*, it will be part of a belt 10″ wide, and the length of arc of contact on the pulley in the direction of motion will be 5″.

But suppose, on the other hand, that this piece of leather is part of a belt whose direction of motion is towards *C*, and it will be part of a belt 5″ wide, and the length of arc of contact on the pulley in the direction of motion will be 10″. If, then, the power required to slide the leather on the pulley surface be, say, 2 pounds, whether applied in the direction of *A*, or of *C*, we have as follows for the two cases: Area of contact, equal; pressure of leather to pulley, equal; arc of contact in direction of motion in one case, 5″; arc of contact in direction of motion in the other case, 10″; power required to move piece of belt in both cases, equal; width of belt with 5″ arc, 10″; width of belt with 10″ arc, 5″.

All your correspondents, save one, neglect the width of the belt part of the question, while I referred particularly to it when referring to the arc of contact. This one, however, makes a general statement that the width does not influence the driving power. I suggest that he cut a belt to half its width along half its length, load it to the slipping point, and see whether the wide or narrow part slips. JOSHUA ROSE, M.E.

New York.

LINE SHAFTS AND COUPLINGS.

Editor American Machinist:

Reading Chordal's interesting communication about line shafts and couplings in the MACHINIST of November 20, impels me to say a few words on the same subject.

I don't know if any one ever made a line shaft 400 feet long in one piece, but I once made one 96 feet long, and could make one any length that could be handled, in the same way, which was as follows:

Six pieces of 2″ shafting were turned in the usual manner, except that the ends were cut slightly conical, and far enough back to cut the centers entirely out; the pieces were 16 feet long; an open forge, with plenty of room all round, was used for welding the pieces together; a row of trussels, each carrying a notched block, were lined up level with the top of the forge, and temporarily nailed to the floor; the anvil was then raised until the shafting, laying in the notches of the trussels, would have a good bearing.

Two pieces of the shafting were then laid with their ends in the fire, and welded end to end in the fire by driving on the end of one of the pieces; then by drawing it endwise, without lifting, brought on the anvil and swaged so as to leave it a little full at the weld; the weld was then straightened, using a straight edge with a gap cut out of the center to go over the weld; another piece was then welded in the same manner until all the pieces were welded together.

The welds were then turned by a traveling "head," similar to those used in some shops, to finish shafting to gauge, and fed to its cut by a device similar to the thread starting device used on pipe plates, except that the thread was very fine and 15 inches long; the shaft was revolved by a pulley and belt, the head being held stationary.

This shaft gave great satisfaction, running quite smooth and free, and, I have no hesitation in saying, was superior to a shaft in short sections, no matter how good the couplings.

I have sometimes used couplings, too, and whenever I had my choice, I always made them in this way: Say I had to couple a two-inch line shaft; I got castings of "sleeve" couplings 6″ long and 6″ diam., and bored them out, tapering from each end $\frac{1}{16}$ inch to the center. Any machinist could turn the shaft to fit this taper, as he would be used to fitting piston rods to cross heads in the same way. I then drive the sleeve on the shaft tight, and drill a $\frac{3}{8}$-inch hole through sleeve and shaft, and follow with a tapering reamer.

I then turn a pin to fit this hole, and cut it off $\frac{1}{4}$ inch short of the diameter of the sleeve; mark the pin, sleeve and shaft, then take it apart and fit the other end of the sleeve to the next piece of shafting, being careful that the ends of the two pieces do not butt together, and the job is done.

I know many of your readers will say I am about fifty years behind the times; but I will venture to say that if this coupling had never been known, and was just invented and patented *now*, it would prove a formidable rival to the best "compression" couplings in the market. It comes as near making a shaft "one piece" as any coupling I ever saw, and costs much less than any other. Yours, P. J.

WONDERFUL SCREW CUTTING.

Editor American Machinist:

In a late number of the AMERICAN MACHINIST, Andy, of Charlotte, N.C., informed us that he cut a screw 9 ft. long, $3\frac{3}{16}$″ in diameter, 1″ pitch, $\frac{11}{32}$″ depth of thread, in 1 hr. 46 min. He does not state whether of brass or wood. If of iron or steel, I do not credit it. He would have to make five cuts of $\frac{1}{16}$″, leaving $\frac{1}{32}$″ to finish bottom of thread. I never have seen a lathe that would cut $\frac{1}{16}$″ deep and cut it smooth enough for a finish. To make a nice job, the sides must be gone over with. What are the screws for, that they do not require the proper depth of thread? Yours truly,

T. H. POLLARD.

Plainfield, N. J., Nov. 28.

A FOUNDRYMAN GIVES SOME HINTS TO FOREMEN MACHINISTS, AND PATTERN MAKERS.

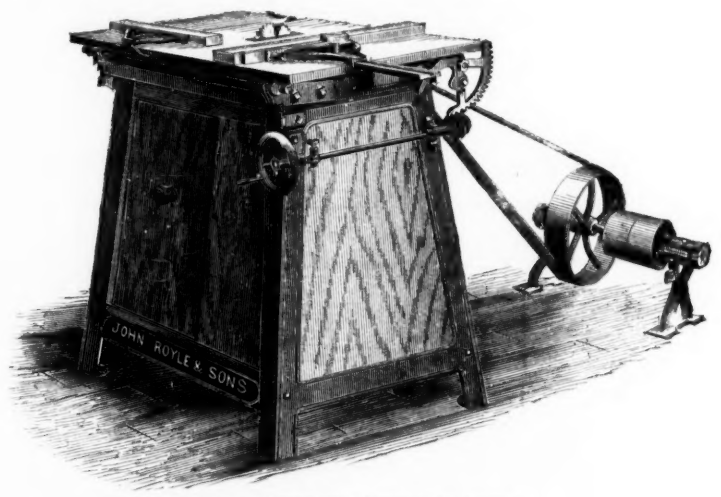
Editor American Machinist:

After reading the letter, or "Notes of a Foreman," on castings, I wish to thank the writer for his allusion to moulders, even if he is seemingly unkind. I will most meekly submit a few facts about castings to his unbiased consideration:

First and foremost: Machinists, pattern makers or draughtsmen never consult, or think of consulting, a foundryman as to the best way of making a pattern, and if the foundryman sees the pattern during construction, and offers a suggestion, he is generally unnoticed. If he is one of those chaps who won't be coughed down, he is effectually silenced by being informed that the "drawing calls for it." The pattern maker will not go behind the drawing, you know.

Secondly: The foreman machinist in urgent need of castings will have patterns made, and will wait until the blast is on before giving them to the foundry. The job is then a hurried one, and has to be given to the moulder who has the most time, without regard to his ability.

Thirdly: There is, always was, and, I fear, always will be, an uncertainty attending the making of castings, for there are a multitude of little matters that affect results in iron founding. A foundry will get a supply of iron, and everything move along smoothly, until it is used up, poor castings being the exception; then a streak of economy will strike the proprietor, and he will buy a "very fine and excellent" brand of iron at $2 less per ton than the iron he has been using. In comes the cheap iron, and out go the questionable castings that my friend alludes to. But the unquestionable ones go on to the stage to be melted over again. After this kind of nonsense has cost the price of best cold blast, new iron, of better quality, is obtained, and things get into their normal condition, and remain so until another economic wave breaks over the head of the concern.



NEW CIRCULAR SAWING MACHINE.

It is safe to say that the above-mentioned experience is met with twice a year in 75 per cent. of all the foundries in this country.

Fourthly: It often happens that a nice pattern is finished by our friend in the machine shop. But when you attempt to draw it out of the sand it is discovered that the draw holes have not been tapped, or the tap does not correspond with a screw in the shop. But the casting must be made, as it is called for in a hurry, so a make-shift is devised of anything to get it out. If a screw is found to fit, it will last, ordinarily for casting about twenty-four times when hole and screw will be worn out. Cause—too fine a thread.

Now, I would like to have a little information from some pattern maker—a regular graduate from the best school. Why do you, in making core prints, make the bottom one on a hub straight? Straight core prints have caused more bad castings and profanity than can be calculated. They should be tapered both top and bottom, so as to leave the sand undisturbed. If a core lies horizontal, make your distance on prints $\frac{1}{4}$″ more; if the core sets perpendicular, make box $\frac{1}{16}$ longer, but never shorter.

There is one fact applying to the foundry that pattern makers never will understand: A core of sand cannot be put into a hole in the sand when both are of the same size without disturbing the sand and causing it to crush, if the core is horizontal when in position.

In conclusion I will merely mention, for the information of everybody having anything to do with patterns, that they (the patterns) will not draw very well when the largest end has to come out last. There are a great many who, it seems, never will understand that simple fact in pattern making. A FOUNDRYMAN.

Toledo, O.

Circular Sawing Machine.

The machine herewith illustrated has some very convenient devices which render it specially desirable for jobbing purposes and for fine and accurate sawing.

It is provided with an iron top three feet in width and two feet in length. For light sawing this is an advantage, as it enables the sawyer to reach the back of the table for the purpose of removing the work as it leaves the saw.

On the hinges of the iron top the table may be raised for the purpose of changing saws, throat piece, etc. By means of the worm and wheel shown on side of machine, the table may also be raised and lowered for sawing purposes. The throat piece is simply a plain piece of hard wood 11x2½x⅜ inches. It can be made and inserted by the sawyer in a very few moments, thus enabling him to have a fresh throat, with a sharp, close fitting opening for the saw at all times.

In the top are planed V grooves for guiding the cross slide and ripping gauge. These grooves have beveled (or V) sides to provide for wear. The ripping gauge is provided with an adjustable iron fence, in which is arranged a convenient detachable device for securing gauges of various shapes and for special work.

The spindle is of steel with A collared, carefully ground bearings. The boxes are of Babbitt metal and are self-oiling. Saws nine inches in diameter may be used, and will project through the table three inches. The machine is fitted up in cabinet style, with a spacious, closely fitting sawdust drawer, making a neat and cleanly arrangement. It is driven by a 4-inch endless belt, which is made without rivets or lacing.

The counter shaft is provided with one pair of 7x4 inch pulleys, and one 18x4 inch pulley. It should make 500 revolutions per minute. The boxes are self-oiling. When convenient the counter may be placed beneath the floor.

The machine is well adapted to the use of electrotypers, stereotypers, engravers, joiners, pattern, model, cabinet, piano and organ makers, in fact, all joiners or workers of wood who use seasoned material. This machine is made by John Royle & Sons, Paterson, N. J.

LOCOMOTIVE FIRING.—An engineer on one of the Indianapolis roads, who prides himself greatly, in connection with his fireman, as to their economy in use of fuel, recently remarked that his success was, in a large measure, due to the fact that he broke his block coal up as fine as nut coal before using it, and that by this method he could get 20 per cent. more steam out of a ton of coal than could an engineer who burns the coal as it comes, regardless of its size. Another part of his statement was that his fireman paid special attention when throwing fuel into the fire box to drop it where it is needed, the secret of firing successfully being to have an even fire all over the fire box.

NEW RAILROAD CONSTRUCTION.—The *Railroad Gazette*, of December 3, gives a total of 101 miles of new railroad. The construction thus far this year is 5,443 miles, against 3,263 miles reported at the same time in 1879, 2,126 miles in 1878, 1,964 miles in 1877, 2,153 miles in 1876, 1,176 miles in 1875, 1,731 miles in 1874, 3,456 miles in 1873, and 6,559 miles in 1872.

A trial was made in Berlin the other day in presence of Count Moltke, of a newly invented traction engine, adapted to military purposes. This engine drew five heavy guns of 15-centimeter bore through the streets for over two hours, at the cost of two marks an hour. The trial was considered by Count Moltke and the staff very satisfactory. Probably the traction engine will become an institution in the German army.

High Ratios of Expansion and Distribution of Unequal Pressures in Single and Compound Engines.

BY J. C. HOADLEY, C. E.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Continued from last issue.

Fig. 18.—In this figure we have a development of the diagram, Fig. 17, on a cylindrical envelope of the crank-orbit.

The center line RR' here represents the developed path of the crank pin during one stroke, the return stroke being along the same path, from R' to R. The parallelogram $RABR'$ represents uniform horizontal pressure on the crank pin during the stroke *from* the crank, and the equal and similar parallelogram $R'A'B'A$ represents equal uniform pressure during the return stroke.

The full lines across the shaded space indicate the eighteen equal angular intervals of 10°, passed over by the crank in equal times. The dotted lines across the whole diagram, but most conspicuous where they cross the white central space, correspond to equal intervals of piston motion, and are numbered 1, 2, 3, &c., above the axial line for the forward stroke, and below it for the return stroke. The tenth of stroke nearest to each dead center, occupies as much time as the three-tenths nearest to mid stroke; and the resistance of uniform friction on crank pin and on crank shaft is proportioned to the time—is equal for equal intervals of crank motion, irrespective of inequalities of piston motion. Work done by the steam, on the contrary, is directly proportioned for equal and uniform pressure to the piston speed; is equal for equal spaces passed over by the piston in equal times, quite irrespective of varying relative crank velocity. Piston speed, as usually reckoned—the length of stroke in feet multiplied by the number of strokes per minute, giving the velocity of piston in feet per minute—is a mean velocity, agreeing with the actual velocity only at two instants during each stroke. Multiplied into the *uniform* pressure acting on the area of the piston, it gives the power correctly; but multiplied into the *mean* pressure, obtained by integrating the widely varying pressures of a diagram, with a high ratio of expansion, it does not of necessity give the power correctly.

A familiar example of the fallacy of averaging two sets of co-ordinates is to be found in the different areas of the two sides of a piston. The area of cross-section of piston rod reduces the area of the side nearest to the crank usually almost 3 *per cent.* It is customary in crude calculations to take the mean area—that is, to deduct half the area of piston rod cross-section from the area of cross section of the cylinder, and this gives a correct result in the rare instances when the mean effective pressure is equal on the two sides; in all other cases it introduces an amount of error proportioned to the inequality of mean effective pressure—an error often quite important in estimating the performance of an engine. Now the variations of pressure, with high ratios of expansion, are very great, and it cannot be a matter of indifference that the pressure acting on the piston half the time, in the end quadrants, at piston speed below the mean, is much above the mean pressure; while the pressure acting on the piston the other half of the time in the mid stroke quadrants, at piston speed above the mean, is below the mean pressure.

Nor does the beautiful and important action of inertia, in the reciprocating parts, altogether remedy this inequality of pressure. Between the two end quadrants, or half quadrants, indeed, it may be made to produce substantial equality, and between the mid-stroke quadrant and the half quadrant at the ends, the inequalities may so be greatly reduced, but only by diminishing the pressure on the crank at one end, and correspondingly increasing it at the other end. Between the two ends of the mid-stroke quadrant, too, the pressure may be completely equalized by this agency. But nothing can be transferred from the high initial pressure in the first half quadrant, to the lower pressure at mid stroke, produced by high ratios of expansion. This figure, 18, like the last, of which, indeed, it is only an exemplification, can lay no claim to geometrical accuracy, and leads to no trustworthy numerical results. The tables which follow have, therefore, little value, but are inserted as only another manner of presenting the substance of this and the preceding diagram. The results are the ratios of areas by planimeter measurement:

In terms of the whole area of each Quadrant:	PARTS IN ONE HUNDRED. Net Rotative.	Fricti'nal Rotative.	Non-Rotative.	Total.
End Quadrants	20.5	18.2	61.3	100.0
Mid-stroke Quadrants	85.6	5.4	9.0	100.0
In terms of the area of whole-stroke				
End Quadrants	10.3	9.1	30.6	50.0
Mid-stroke Quadrants	42.8	2.7	4.5	50.0
	53.1	11.8		100.0

Fig. 19. This represents an ideal diagram with twelve-fold expansion; initial pressure, P_1 = 120 lbs. + atm. = 134.7 absolute; terminal pressure, P_2 = 11.225 lbs. abs.: back pressure, P_3 = 2.7 lbs. absolute.

The horizontal pressure on the piston is represented by the hyperbolic curve $P_{1\frac{1}{3}}$, A'', $P_{2\,1\frac{1}{3}}$; the horizontal pressure on the crank pin, by the line P_1', AA'', $P_2'{}^{1\frac{1}{3}}$, and the tangential pressure on the crank pin by the line $SA'A''S'$.

The horizontal pressure on the crank pin is exactly the same as that on the piston (no account being here taken of friction), as the pressure is distributed upon the several parts of the stroke, as much being added to the last half of the diagram of piston pressure as is taken from the first half, upon the assumption that the inertia of reciprocating parts at dead center is equal to one-half the absolute initial pressure=67.35 lbs. per square inch of piston area. The rotative effect is nearly, perhaps exactly, the same upon the crank pin, whether reckoned from the horizontal diagram of piston or crank pressure.

The slight difference of 2.5 per cent., which appears in the subjoined table (25.93 and 26.27), may result from some slight error in my numerical calculations, which I have not been able to detect. I see no reason why they should not be alike.

	TOTAL HORIZONTAL PRESSURES. On Pistons.	Effect of Reciprocating Parts.	On Crank.	TOTAL ROTATIVE EFFECT. Diagram Unmodified.	Modified by Reciprocating Parts.
First 0.15 of stroke	118.76	— 57.24	= 61.52	50.77	28.37
0.15 to 0.50	38.62	— 23.57	= 15.05	34.03	13.61
0.50 to 0.85	17.02	+ 23.58	= 40.60	15.70	36.09
0.85 to 1.00	12.16	+ 57.25	= 69.41	6.05	33.12
Both ends, 0.15×2=0.30	65.46	0.00	65.46	28.41	30.74
Mid stroke, 0.35×2=0.70	27.82	0.00	27.82	24.87	24.85
Whole stroke	39.11	0.00	39.11	25.93	26.62
Whole stroke, mean	39.11	0.00	39.11	26.27	26.27

The pressures in the foregoing table are all absolute. I assume that back pressure on the piston, occasioned by pressure in the condenser, will be 2.7 pounds. This must be subtracted from all horizontal pressures, and a due proportion of it from all rotative pressures, and the result will be seen in the next table:

1	EFFECTIVE HORIZONTAL PRESSURE. On Pistons. 2	Effect of Reciprocating Parts. 3	On Crank. 4	TOTAL ROTATIVE EFFECT. Diagram Unmodified. 5	Modified by Reciprocating Parts. 6
First 0.15 of stroke	116.06	— 57.24	58.84	49.62	27.11
0.15 to 0.50	35.92	— 23.57	12.35	31.65	11.17
0.50 to 0.85	14.32	+ 23.58	37.90	13.21	33.69
0.85 to 1.00	9.46	+ 57.25	66.71	4.71	31.83
Both ends, 0.15×2=0.30	62.76		62.76	27.16	29.47
Mid stroke, 0.35×2=0.70	25.12		25.12	22.44	22.43
Whole stroke	36.41		36.41	24.13	24.78
Whole stroke, mean	36.41		36.41	24.59	24.59

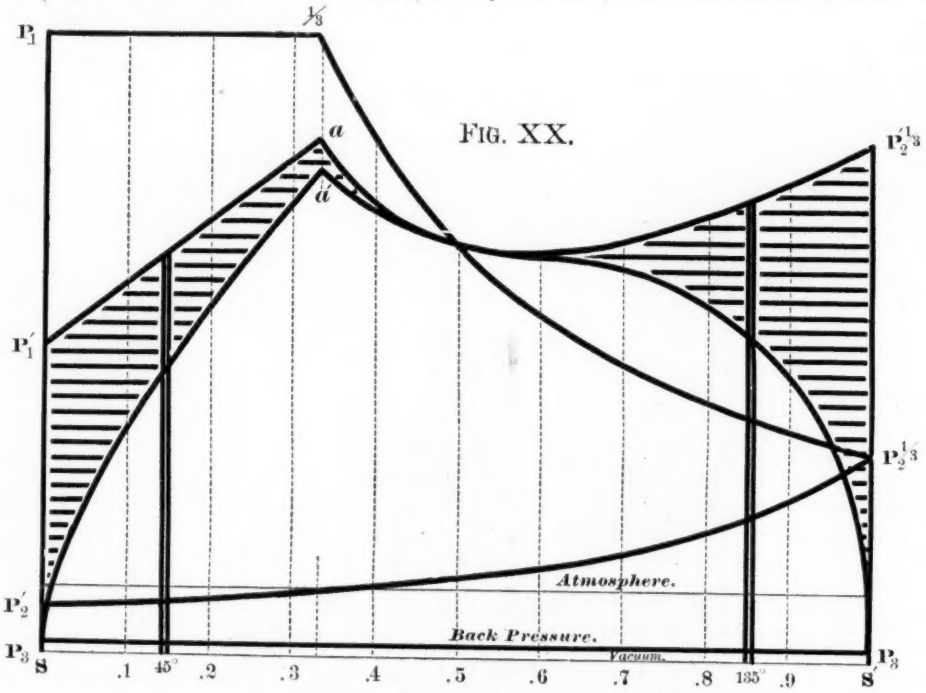


FIG. XX.

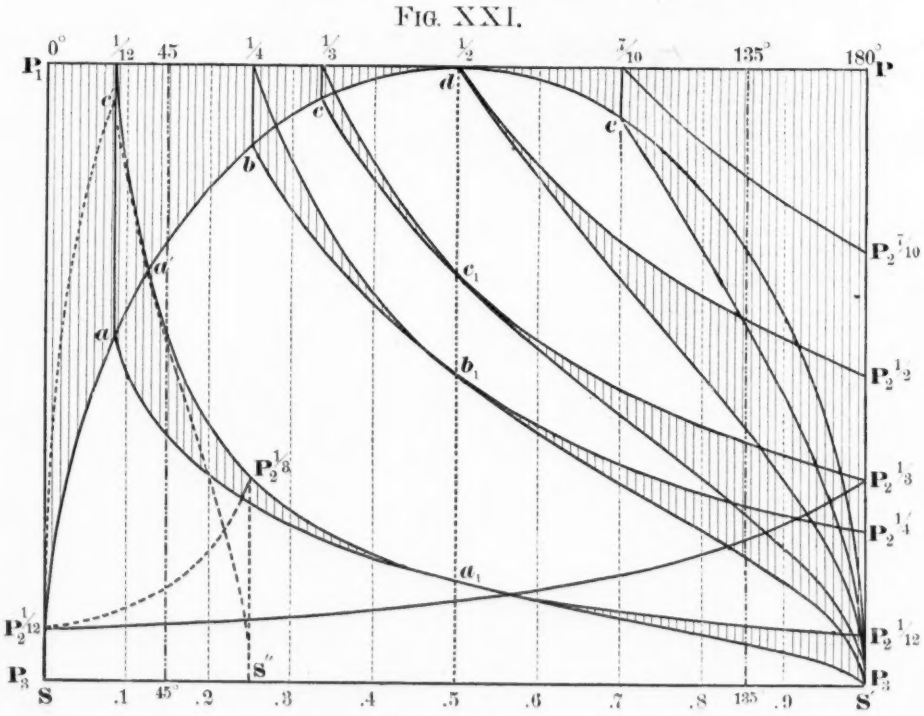


FIG. XXI.

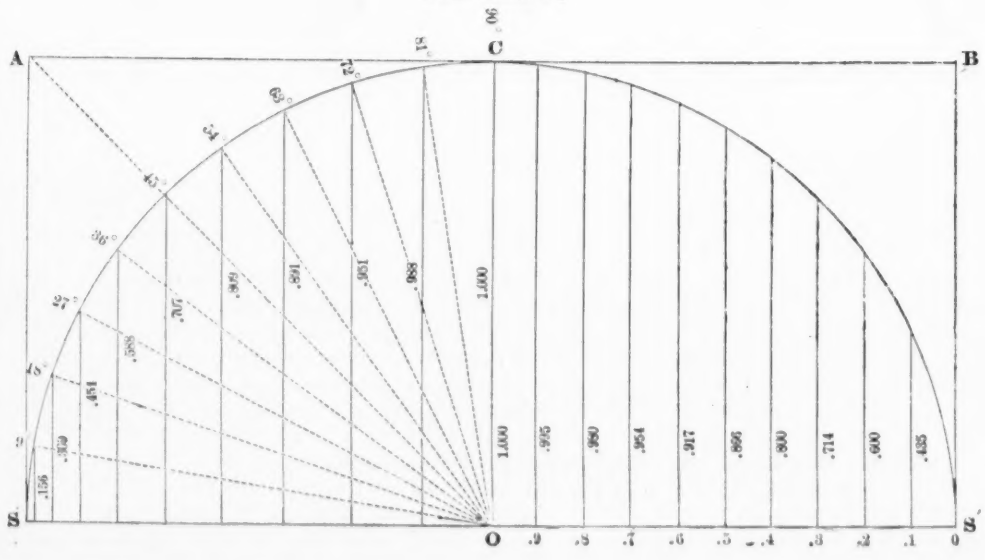


FIG. XXV.

It will not be overlooked that the subtraction of a constant from variable pressures, changes materially their mutual proportions. For example, the rotative effect, last 0.15 of stroke, unmodified diagram, (4th column, 4th line), is reduced no less than 22 per cent., while that in the first 0.15 of stroke (4th column, 1st line), is reduced only 2.2 per cent., only one-tenth as much in proportion to its magnitude.

It will be seen by a comparison of the four first numbers in the last column of table on page 6, that the rotative effect of the first and last quadrants is pretty nearly equalized, but that a little too much has been transferred from the first part of the stroke to the last. In the mid stroke, considerably too much has been transferred from the first to the last half. Of course, the remedy is to give less value to the inertia of the reciprocating parts. The weight of these parts can only be varied within very narrow limits, and will generally range between 2.5 and 4.0 pounds per square inch of cylinder cross section. But the speed is usually determined by the judgment of the engineer or designer of the engine, and should be carefully adjusted to the requirements of the diagram.

Clearance and compression have been omitted, to avoid needless complication.

Of course, both have their importance, but their introduction here would, it is thought, only tend to confuse.

It may not be out of place here to call attention to the relation of the area representing rotative effect, to the diagram of horizontal piston pressure upon which it is traced.

Referring to Figs. I to V, it was correctly stated that the ratio of the area of rotative effect is to the area of the circumscribing parallelogram, square, lozenge, or other figure representing horizontal piston pressure, as $\frac{\pi}{4}$ to unity. Yet this quantity, say 0.7854, (radius or crank being unity) if multiplied by the mean piston pressure and area, and by the velocity of the crank, will give a result, as power, considerably in excess of the true result, to be obtained by multiplying the effective piston pressure, area and mean velocity continuously together. In fact, the true coefficient of rotative effect is $\frac{2}{\pi}=0.63662$, instead of $\frac{\pi}{4}=0.7854$.

The reason for this is, that the *area* is to be obtained by integrating the sines of angles corresponding to equal successive differences of co-sines (ds), while the mean rotative pressure is to be obtained by integrating the sines corresponding to equal successive differences of arc ($d\alpha$).

Fig. 25 illustrates this. The arithmetical mean of the numbers representing the length of sines at .1, .2, .3, etc., dividing OS' into ten equal parts, will give 0.7761, which differs but little from $\frac{\pi}{4}$, and would agree with it exactly if taken at infinitesimal intervals. On the other hand, the corresponding mean of the sines of the equal angles, 9°, 18°, 27°, etc., which divide the arc SC into ten equal parts, will give 0.6352, a still closer approximation to $\frac{2}{\pi}$, with which it would exactly coincide if the divisions of the arc were sufficiently minute.

It follows, then, that while the curves of rotative effect correctly represent this force upon the diagram, its mean value, for multiplying into piston area and crank speed to obtain the power, must be found by multiplying the mean effective pressure on the piston by 0.63662: or by dividing it by the reciprocal of that number, $\frac{\pi}{2}=1.5708$—the ratio which crank speed bears to piston speed.

We may now make a more particular application of the foregoing principles to a comparision of the distribution of the unequal pressures, resulting from high ratios of expansion, in single and in compound engines.

Fig. 19. This figure will require but little explanation. It represents a diagram with twelve-fold expansion, from 134.7 pounds absolute at P_1, $P_1^{\frac{1}{12}}$, to 11.225 pounds at P_2 $^{1\frac{1}{12}}$, in a single cylinder. The horizontal pressure P_1', $A\,A''P_2{}'^{1\frac{1}{12}}$, and the tangential pressure $SA'A''S'$, are determined upon the assumption that the weight and velocity of the reciprocating parts are such as to absorb half the absolute initial pressure on the piston, and transfer it to the end of the stroke.

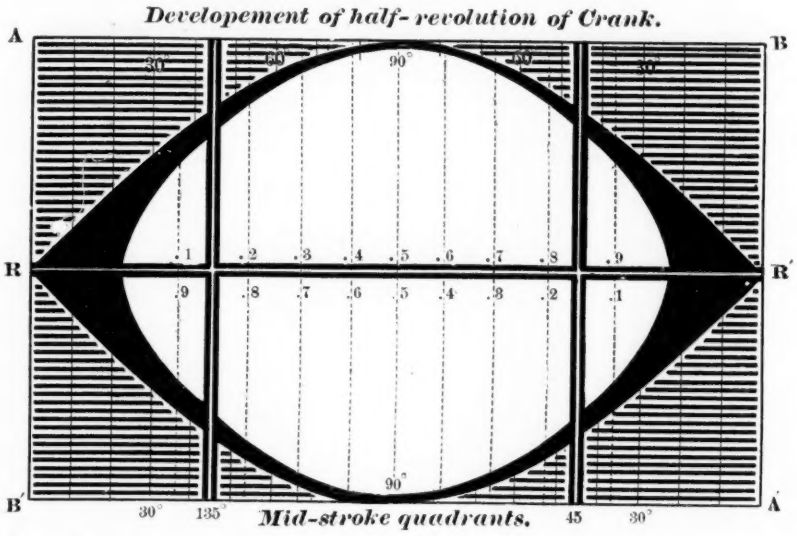
This, it will be seen, shows much more than half the work done in the last half stroke; but such excess might be reduced to any desired extent by reducing the speed.

The double vertical lines marked 45° and 145°, about 15 per cent. from each end, divide the mid-stroke quadrant from the two end half quadrants.

(*Concluded on page 9*)

FIG. XVIII.

Developement of half-revolution of Crank.



Mid-stroke quadrants.

FIG. XIX.

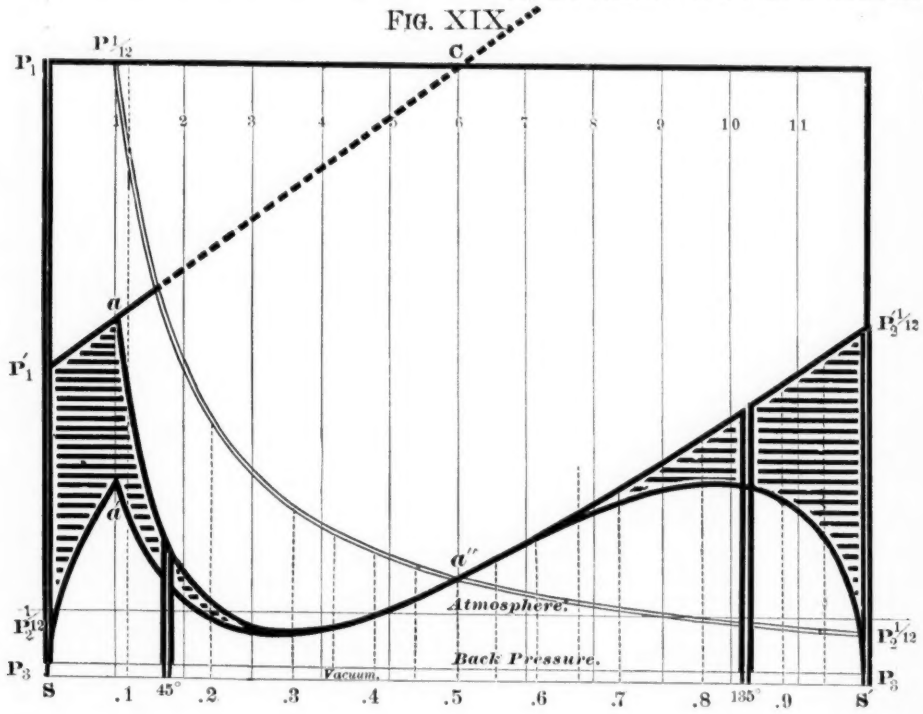


FIG. XXIV.

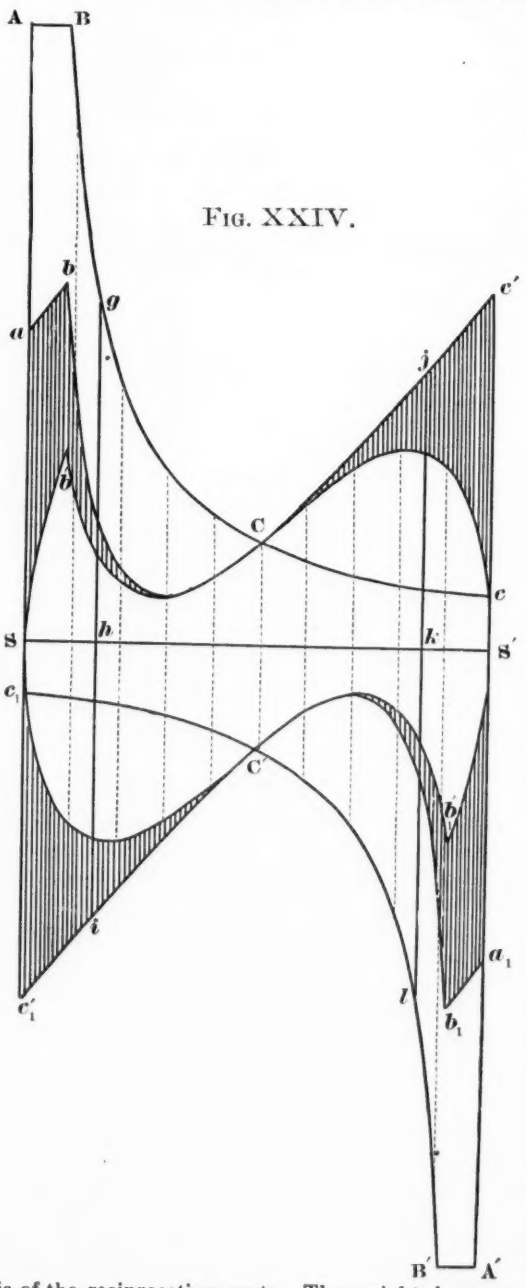


FIG. XXII.

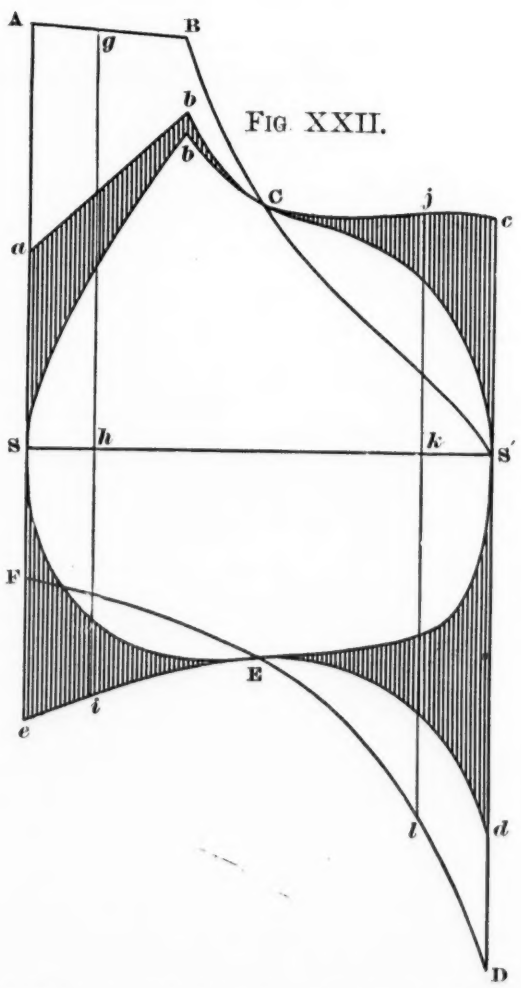
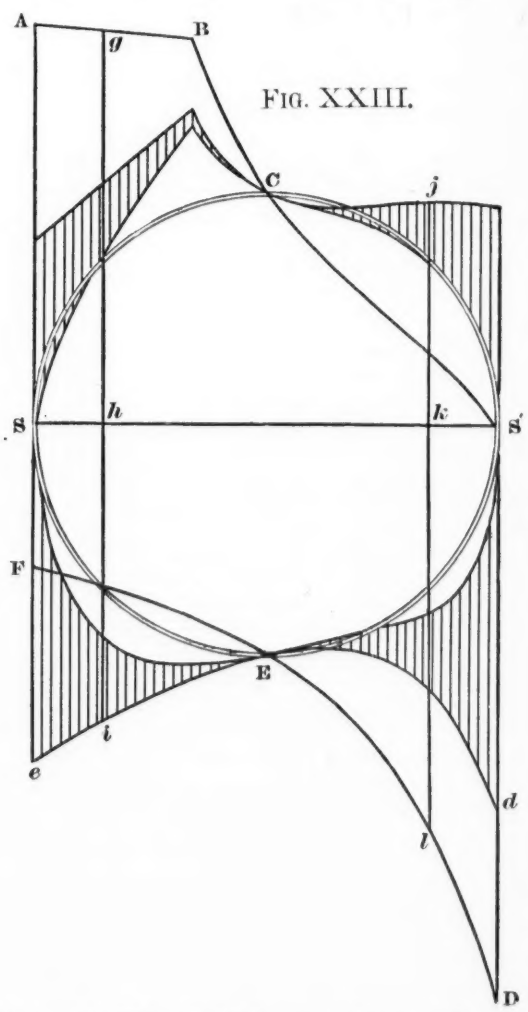


FIG. XXIII.



AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Prest.

JACKSON BAILEY, Vice-Prest.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

LEWIS F. LYNE, Mechanical Engineer.

The American News Company,

Publishers' Agents, New York.

The International News Company,

(Formerly the Wilmer & Rogers News Co.)

11 BOUVERIE STREET, (Fleet St.) LONDON, ENG.

Will receive subscriptions for the AMERICAN MACHINIST at 17 shillings per annum, postage prepaid.

DEALERS SUPPLIED BY

The New York News Company, New York.
The National News Company, New York.
The New England News Company, Boston, Mass.
The Central News Company, Philadelphia, Pa.
The Western News Company, Chicago, Ill.
The St. Louis Book and News Co., St. Louis, Mo.
The Cincinnati News Company, Cincinnati, Ohio.
The Detroit News Company, Detroit, Mich.
The Pittsburgh Book and News Co., Pittsburgh, Pa.
The Baltimore News Company, Baltimore, Md.
The Rhode Island News Co., Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The Brooklyn News Company, Brooklyn, L. I.
The Newark News Company, Newark, N. J.
The Northern News Company, Troy, N. Y.
The Albany News Company, Albany, N. Y.
The Washington News Co., Washington, D. C.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.

$3.00 a year, in advance, postage prepaid in the United States and Canada.
$4.00 to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 30c. per line, (12 lines one inch.)
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses.*

☞ *Subscribers who fail to receive their paper promptly will please notify us at once.*

☞ **Entered at the Post Office at New York, N. Y., as second class mail matter.**

NEW YORK, DECEMBER 25, 1880.

CONTENTS.

PAGE.

Improved Woodworking Car Machinery..... 1
Extracts from Chordal's Letters..... 1
Navy Yard Test of the Anthracite..... 2
Jewelers' Impression Mill..... 4
Letters from Practical Men..... 4
High Ratios of Expansion and Distribution of Unequal Pressures in Single and Compound Engines. J. C. Hoadley, C. E..... 6
A Christmas Greeting..... 8
As Others See Us, and as We See Them..... 8
Comments upon Trials of the Anthracite..... 8
Literary Notes..... 8
Questions and Answers..... 9
Newly Incorporated New York Companies..... 9
Manufactures..... 10
Machinists' and Engineers' Supplies..... 10
Iron Review..... 10
Metal Review..... 10

The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

A Christmas Greeting.

By a pleasant chance the present number, with which also closes Vol. III. of the AMERICAN MACHINIST, bears date December 25, the day known to the civilized world as "Christmas." By common consent childhood and age have united for centuries in the special observance of this holiday in many ways; not the least important of these being the filling of juvenile stockings with gifts, and the hearty interchange of the familiar greeting, "Merry Christmas." This greeting the AMERICAN MACHINIST takes especial pleasure in extending at this time to all its thousands of readers and friends, and the more heartily because the many warm expressions which we are daily receiving, have almost accustomed us to regard every reader as a personal friend.

With some publications it has long been a custom to issue a special number at this season, called the "Christmas number," presumably somewhat on the theory that the gift of extra reading matter at Christmas time is in order.

Unless a convenient Index to the topics treated of during the year may be considered as such, the AMERICAN MACHINIST publishes no "Christmas number," our effort being to make every number a Christmas number with respect to the value of its contents.

Right here, it may not be amiss for every reader of these lines, be he employer or employe, to ask himself during the last week of the year, what Christmas gift of better tools, systems and appliances upon the one hand, or thoughtful service upon the other, it may be in the power of each to render for the ensuing year to those with whom he comes in contact. Lubricating the wheels of life with Christmas oil in this fashion may easily be counted upon to produce pleasant and profitable returns all round. We close this article by heartily wishing to all our friends a Merry Christmas and Happy New Year.

As Others See Us, and as We See Them.

We copy the following lengthy extract from an article in a late issue of the *Engineer and Iron Trades Advertiser*, of Glasgow, which seems to have been prompted by a perusal of the editorial pages of the AMERICAN MACHINIST of October 30 and November 6:

The Yankees, however, out of their multitude of notions bring to perfection so many noble works that, joking aside, we are glad to embrace the advantages they bring with them. We owe them, it must be admitted, a great deal for their improvements in machinery, and to no country do we look with greater interest for further advances in this respect. To talk of their activity and push, and to admire their earnestness and energy, is all very well; but to allow that they have the best of us in inventive force of character is, however necessary an admission, somewhat humbling to the British mind. We, too, of course, are earnest, pushing and inventive, but there is a want of "experimenting" among our manufacturers, which is a striking characteristic of the American people. They are not pleased, for instance, with the old-fashioned brooms, and set about the construction of an article capable of doing, with less exertion, the same amount of work accomplished by the clumsy hairy-headed mop so long in use with us. They invent machinery for milking cows, and, encouraged by the hint supplied from this side of the water, an attempt is being made, it has been dryly said, to perfect a machine for the manufacture of the animals themselves. In short, from kitchen ranges to hair pins, the Yankees have effected improvements, and a constant perusal of the journals published in the States justifies the expectation that the culmination of their innovations will result in a new order of things altogether for household and manufacturing purposes. Looking over a New York journal devoted to mechanical interests, the headings of three articles, viz., "A Training Ship for Marine Engineers," "A Plumbing Banquet," and "A Shop Library," encourage the idea that the American success is due, in a great measure, to the advantages offered to artisans by employers of labor, and the interest taken by the masters in the development of the higher accomplishments of their workmen. The Americans have a hankering after the revival of their shipping, which, ever since the introduction of iron for shipbuilding purposes, has been on the decline. They feel, however, and are wide awake enough to admit, that steam must inevitably supersede sails at sea. Engineers, for the guidance of machinery, must be supplied, and for this purpose a training ship, which would undertake the theoretical education of young men anxious to qualify themselves to take charge of steam machinery at sea, is what many consider would be a valuable contribution to the movement for the restoration of their shipping interests. Were the opportunity offered there can be no doubt that many young men would take advantage of the education supplied in such a floating school. The scheme is a good idea, and were it carried out more extensively in our own country, fewer breakages in valuable engines would grieve those who, after launching out large sums of money in their perfection, are frequently startled by the announcements that through want of the first principles of knowledge in their guidance, machinery and ships have been twisted and broken beyond the hope of repair. Another aid to American mechanics is offered in the frequent meetings of workmen and masters at dinner parties to compare their views on the labor questions of the day. This, it must be admitted, is a new departure in the previously existing relations between the masters and men of the new world. But, if properly conducted, it will be seen at a glance that the greatest good may be derived on both sides. Intentions and inventions can, at such gatherings, be explained on the one hand, and practical hints given on the other. Besides, a thorough understanding can be arrived at as to the working and manipulation of new designs, and if this is achieved, the masters will not have had the worst of the little dinner party, whether given to plumbers, engineers, or blacksmiths. The Shop Library scheme, however, is one which, it is feared, is not very extensively countenanced among manufacturers here. In America the shop libraries are encouraged in many extensive works, and the results are very gratifying. Judicious reading has produced increased practical knowledge among the workmen where libraries have been instituted and encouraged. Workmen engaged on special jobs find volumes in such libraries containing information applying directly to the work in hand; apprentices, if occasionally showing a weakness for romances and piratical adventures, are encouraged in their whims with the view of supplying stronger food as their intelligences enlarge and their minds expand. Everything, in short, is done to induce a taste for reading among all employed, the object being to inspire the workmen to greater things in the future, and to incite them to improve in the quality and finish of jobs with which they are entrusted. With such encouragements before them, and with such improving elements at their command, the artisans of the United States, loquacious and bragging though some of them may be, have the pull over those in this country who do not seek to improve their status by every aid afforded them through the educational agencies established by those whose prosperity in a great measure depends on the intelligence of their workmen.

The sentiment which crops out in the above is commendable, yet the tone of the article reveals the real cause of the lack of satisfactory progress among British workmen. No American newspaper would put forth an article upon "the interest taken by the *masters* in the development of the high accomplishments of their workmen," for the simple reason that no class of men in this country are recognised as *masters* over workmen. We have no doubt that the British workman with the same conditions existing around him would develop as much "inventive force of character" as the American, but, under the system in which he forms one of the most necessary factors, he does not so develop, nor can it be expected that he will. The trouble lies in the social and political systems under which he is obliged to exist. It is said, and truthfully too, that the artisan of England, as a rule, manifests but little desire to read books or periodicals relating to his occupation, or to improve himself by study. The cause is not very obscure. When workmen are regarded socially, and are treated much like serfs or animate machines calculated to do a certain amount of work for the least amount of money that will keep the machine in operation, without the prospect of anything better, they cannot be expected to be very ardent in the pursuit of practical knowledge, especially as its benefits would accrue more to *masters* than to the workmen themselves. In America, both social and political economy are in favor of the advancement of the worker for wages. Here, if the worker for wages aspires to be proprietor of a shop and an employer, he is not looked upon as an "upstart," but is encouraged by all classes of citizens. Not so in England. The ethics of caste in that country, strengthened by the traditions of centuries, the free-trade system and property laws for the maintenance of extensive landed estates, render it almost impossible for the artisan, with nothing but his own ability to depend upon, to ever become a "master."

Is it a matter of wonder that strikes and labor troubles have become chronic in Great Britain? Is it strange that British workmen, as a rule, are to be found in the grog shops on Monday, after pay day, rather than in the workshops? Why should it surprise anybody that British artisans make fewer inventions than those of America? There is no prospect of any change in the industrial aspect of affairs in England, or their general tendency in our own country.

Comments Upon Trials of the Anthracite.

We publish elsewhere in the columns of the current issue the results obtained during the late test of the machinery of the Anthracite at the Brooklyn Navy Yard, which have not been published until now, although brief extracts from the tests showing partial results have appeared in some of our exchanges. The results of the Navy Yard test were, an expenditure of 2.7115 pounds of coal per indicated horse power per hour, while Mr. Bramwell's report showed an expenditure of 1.7114 pounds of coal per indicated horse power per hour. The causes of this highly economical result is owing chiefly to the following facts: The coal used during his experiment produced only 5 per cent. of white ashes, with no clinker, while the coal used during the Navy Yard test produced 17.6363 of refuse, with a large percentage of clinker. The loss occurred from the cooling of the boiler, caused by the constant opening of the furnace door in firing. The steam pressure carried was also much lower than in Mr. Bramwell's experiment, and the water being carried much higher in the boiler prevented the development of the advantages to be obtained by superheating. In short, the less amount of superheating, together with the greater amount of cylinder condensation can be considered as the causes of the discrepancy between the two experiments. We believe that Mr. Bramwell obtained the results as published in his report, and we regret that more time could not have been allowed to the experiments by the Board of Naval Engineers to develop still further results; however, the tests already made have practically demonstrated that the Perkins system has especial merit in it, the true extent of which can only be fully developed by actual practice on an extended scale.

On the second page we present one of the illustrations from "Extracts from Chordal's Letters," just published in book form. Our artist has sketched a boiler front and surroundings just as he found them in an establishment not far from our office.

Literary Notes.

MATHEMATICAL DRAWING INSTRUMENTS and How to Use Them.—By F. E. Hulme, F.L.S., Art Master of Marlborough College. 16 mo. cloth, 152 pp., illustrated. Price. $1.50. Published by Bicknell & Comstock, 194 Broadway, New York.

The author of this book has been for years an instructor of one of the leading institutions of London, and is, from long experience, well qualified to deal with the subject, putting the instruction in such a way as to be of most practical value to the student. This book is a well-written treatise on the selection, use, and care of mathematical drawing instruments. The young student and apprentice, when attempting to select a box of drawing instruments, is

unable to pay for the very best instruments, and yet desires to procure a set which will do good and reliable service. To decide upon this happy medium is a mystery. The author has attempted to clear up this and other difficult matters connected with the experience of draughtsmen. We understand that this is the first time that he has undertaken to publish his experience. Each instrument is taken up in its proper place, minutely describing its construction and use. Plain instructions are also given in shading, coloring, tracing papers, and copying drawings. The Marquois scale is also described, for shading cylinders, and instructions given for its practical application. The plates are clear and the book is well printed.

The Sanitary Engineer of this city, one of our valued exchanges, begins its fourth volume with the December first issue. The occasion is suitably marked by putting on eight more pages than usual, besides a supplement containing the prize essays of the Committee of Award in the Food Adulteration Competition, instituted by the National Board of Trade. Among the many good things in this number we notice "An Account of the Recent History of Electric Lighting by Prof. Henry Morton, an illustrated description of a tidal outlet for Sewers in New York, Arsenical Wall Papers by Prof. Edward S. Wood, Sanitary Observations by Prof. Henry Robinson of London, Plumbing Practice and other articles written by eminent specialists.

The regular record of new buildings projected throughout the United States is a valuable feature, also the list of patents granted every week relating to plumbing and sanitary matters with drawings and claims allowed.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) L. J. T., Chicago, Ill., asks: Will you please tell me if cast dies of steel would be practicable for trimming light work? Will they be strong and wear good when they are brought to a sharp edge and the punch fits nicely? *A.*—No; it is much more economical to make dies and punches of the best tool steel, and at present low prices of steel the saving in first cost by the use of castings of steel will be a small consideration. You will experience great difficulty in hardening tools made of cast metal, and the edge will soon be destroyed.

(2) W. H. D., Minneapolis, Minn., writes: The parties interested have agreed to abide by a decision of the AMERICAN MACHINIST on the following questions: 1. What size belt is required to transmit 8 horse power from a pulley 46″ diameter, making 120 revolutions per minute, to another pulley 24″ diameter; distance from centers of the shafts, 20 feet? *A.*—A belt made of the best leather, 4″ wide, will easily transmit 8 H.P. under the conditions named by you, while a belt made of common or poor leather will require a width of from 6″ to 7″ to transmit the same power. Belting made of poor leather will soon stretch so as to become so crooked that it will lose the greater portion of its power, and resemble a huge serpent moving over the pulleys. 2.—Please give the difference, if any, when leather or rubber belting is used. In asking you to decide this matter, my friend and I have consulted half a dozen authorities, with M.E. at the end of their names, and none agree. My friend found one formula (he is interested in having a very large belt transmit very little power) taking so much belt to produce 10 H.P. that it would take all the hides in the country to make a belt, and we would have to go without shoe leather. I do not mean any disrespect to the learned men who give us the formula, for they may see it in one light, and be all satisfactory, but it does not appear plain in practice. *A.*—The advocates of rubber belting claim an advantage of 20 per cent. over leather belting, and this may be true; but when the belt has been running for some time it becomes coated with dirt and gum, after which there is no perceptible difference between it and leather. In damp or wet places, where there is sufficient moisture to destroy leather, rubber belts must, necessarily, be used, as it then has decided advantages. Where the atmosphere is dry and not injurious to leather belts, also where a belt requires to be shifted, leather will long outlast rubber. The running conditions of belts are governed by such a variety of circumstances, that it is now, and probably will be, impossible to give a rule to suit all conditions. The best practical method of getting at results is to try experiments under different circumstances, and record those facts for future reference.

(3) J. C. L., Sherman, Texas, writes: I observed, in the issue of Oct. 30, 1880, a device for holding a line for lining up engines, shown at *F*, Fig. 3, on page 7. Would it not be more simple to use a piece of wood, attached to the outside of the cylinder flange, and having a hole by which to bolt it to the flange, allowing it to project a short distance past the center of the cylinder? The hole should be large enough to admit adjusting the line to the center, and the end of the line should be made fast to a small peg, so that when a tension is put on the line it will be held where it is placed. *A.*—The usual custom, and one of the most simple, in holding a line in the bore of a cylinder, is to take a piece of sheet iron, about 1/8th inch thick, and of a sufficient length to reach a little past the center of the cylinder. A slot should be made in one end to admit one of the studs or bolts in the flange of the cylinder. A small hole should be drilled in the other end, just to admit the line. This arrangement allows a person to work all about the line, and does not prevent a free access to the cylinder. 2.—Is the bore of the stuffing box always true with the bore of cylinder? *A.*—When the cylinder and head is new, the stuffing box is, or ought to be, in the center of the bore of the cylinder. It is frequently thrown out through faulty workmanship in boring upon the lathe. But when the bore of the cylinder becomes worn, particularly upon horizontal engines, the stuffing box will be found above the center of the cylinder.

Business Specials.

50 cts. a line for each insertion under this head

Bicycle Repairs, Rubber Tyres, Back Bones, Spokes, Bells, Stands, &c. T. B. Jeffery, 253 Canal Street, Chicago.

Presses and Dies. Ferracute Co., Bridgeton, N. J.

The Best Holiday Present. "Extracts from Chordal's Letters," in book form, now ready. Over 40 Original, Humorous Illustrations. Steel portrait and real name of the author. Cloth. 320 pages. $1.50 by mail, postpaid. American Machinist Publishing Co., 96 Fulton St., New York.

Engine Castings. Complete set for 2 H. P. Engine, $15. W. M. Boyd, Box 793, Pittsburgh, Pa.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at 83 Morgan street, near Washington, Jersey City, N. J.

"Monitor Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

"Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. $1.50 by mail, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

American Watch Tool Co., Waltham, Mass., Whitcomb Watch Makers' Lathes, and Watch Machinery.

Rules for Engineers, and Removal of Scale in Boilers. Send for Circular. Ranken Scale Co., 50 Federal Street, Boston.

Thomas D. Stetson, Patent Solicitor and Expert in Patent Cases, No. 23 Murray Street, New York.

Blowers for all purposes. Exeter Machine Works, 50 Federal Street, Boston.

See Christiana Machine Co.'s adver., last number.

James W. See, Designing and Consulting Engineer, Hamilton, Ohio.

Howard S. Abbot, Attorney at Law and Solicitor of Patents, 617 7th Street, N. W., Washington, D. C. Personal attention given to cases in Patent Office.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

MANUFACTURES.

The Tuttle & Whittemore Malleable Iron Company, at Union City, Conn., have completed the externals of a foundry addition.

The William Bros. Manufacturing Company of Glastonbury, with a capital of $125,000, and the Brackett & Tuttle Company of New Haven, with a capital of $50,000, are newly chartered corporations.

The malleable iron works at Akron, O., which were projected and started by parties with very little capital, have passed into the possession of a company which will push them to an early completion.

Talbot & Sons, Richmond, Va., are making a large addition to their machine shop. This is the third improvement to their extensive works, made within the past two years. They are now preparing to make 400 boilers and engines per annum, besides meeting the wants of their general trade.

The Chicago Malleable Iron Company are building foundry and annealing house.

Tobin & Hamler, boiler makers, of Chicago, are building an extension to their works at a cost of $2,000.

It is stated that the Phœnix Iron Company, of Phœnixville, Pa., are making arrangements to build a new foundry in the rear of the lot on which the present one now stands. The new foundry will have all the modern appliances and be complete in every respect.

A New York foundry which possesses a capital of $50,000, proposes to remove to Westport, Conn., provided $5,000 is raised as a consideration, and the citizens of the place are so enthusiastic over the project that they contemplate bonding the town for that amount.

J. H. Bass, Clark and Forty-seventh street, Chicago, contemplates building an extension to his car-wheel manufactory in the spring. He is employing 300 hands, runs full time, and turns out 70 tons of car wheels per diem.

The Cheney Anvil & Vise Company, of Detroit, are running a large force on their combination anvil and vise, and so great is the demand that they expect to be obliged to make additions to their factory facilities.

The factory of Kearney & Foot, at Paterson, N. J., for the manufacture of hand-cut files, is now running with an increased force until nine o'clock at night, and will continue to do so until the end of the year.

The old Page Plow Works, at Canton (Ill.), are being turned into a glucose manufactory.

L. C. Wead contemplates enlarging the Malone (N. Y.) Paper Mills, of which he is treasurer.

The Springfield Sewing Machine Company of Springfield, Mass., are just beginning to run their factory to its full extent.

The St. Charles (Ill.) File Works are building an addition to their factory and adding some new machinery. Twenty more hands will be employed when the additions are completed.

(*Continued from Page 7.*)

Fig. 20. The same initial pressure, ratio of expansion, terminal pressure, speed, effect of reciprocating parts, and rotative effect that we saw in the last figure carried out in a single cylinder, are here shown as operating in a compound engine, in which the cylinder volumes are to each other in the ratio of 1 to 4. Except the effect of clearances, compression, early release, expansion between cylinders, and, perhaps, other minor causes of irregularity or loss, not necessary to consider here, the diagram of the low-pressure cylinder fills the space occupied by back pressure in the high-pressure cylinder, and the two diagrams produce, with twelve-fold expansion, a combined diagram with three-fold expansion. Acting with a net increase of effect three-fold, by reason of the net increase of volume, it will come to the same thing, if we consider the stroke and area of piston equal, and the mean effective pressure in the low-pressure cylinder three times as great as it actually is. In the high-pressure cylinder, initial pressure being 134.7 lbs., expansion three-fold, and terminal pressure 44.9 lbs., the mean absolute pressure is 94.25 lbs. In the low-pressure cylinder, the initial pressure is 44.9 lbs., the ratio of expansion 4, terminal pressure, 11.225 lbs., and mean total pressure, 20.74. As this latter is the back pressure in the high-pressure cylinder, the mean effective pressure in that cylinder is 94.25—20.74 =73.51. Now,

$$\frac{73.51+(3\times 20.74)}{94.25}=1.44,$$

so that, with constant stroke, if we take the area of what we may call the equivalent cylinder, 1.44 times that of the high-pressure cylinder, we may consider the whole expansion precisely as if it all took place in such equivalent cylinder, with only three-fold expansion. Of course, taking back pressure in low pressure cylinder, clearances, compression, etc., into consideration, would change the above numerical values, but would not affect the general result.

Fig. 21. On this diagram, the same initial pressure as in the two preceding figures, is shown with several different ratios of expansion, namely 12, 4, 3, 2, and 1.43, or the reciprocal of 0.7. In all cases the rotative effect follows the semi-ellipse $Sabcde\,S'$, which would become a semi-circle, if a horizontal scale were taken which would make the half stroke $S.5$, $.5S'$, equal to initial pressure P_3P_1. The expansion curve $P_2{}^{\frac{1}{3}}$ $P_2{}^{\frac{1}{12}}$, is the same as the corresponding curve on Fig. 20; and similar curves might be drawn from the terminal points $P_2{}^{\frac{1}{4}}$, $P_2{}^{\frac{1}{2}}$, etc., of the other curves. The dotted lines $Sc'a'S''$, and $P_2{}^{\frac{1}{3}}$, $P_2{}^{\frac{1}{12}}$, show the rotative effect of the whole twelve-fold expansion, in the "equivalent cylinder," on a base one-fourth the whole length of the diagram, and the expansion in low-pressure cylinder on the same base.

It is thought that this diagram exhibits very clearly the relation of rotative effect to horizontal pressure at different ratios of expansion. Effect of inertia of reciprocating parts is omitted to avoid confusion.

Fig. 22. The effective high-pressure diagram, Fig. 20, is here treated, by itself, as the forward-stroke diagram, and the corresponding low-pressure diagram multiplied by the ratio of net volume of the two cylinders, (3-fold), is taken as the diagram of the return stroke. Of course the proportions could be so taken as to make the work done in the two cylinders equal, when the ratio of the "equivalent" cylinder to the high-pressure cylinder, now 1.44, would become 1.5. The weight, speed and modifying effect of reciprocating parts, are all taken as in case of Fig. 19 and Fig. 20.

These parts are supposed to be solidly united, so as to produce a combined effect, equal in the two cylinders; but when reckoned per square inch of piston area, of course inversely as the respective areas of the two pistons. The distribution of rotative pressure is, in the high-pressure cylinder, very good, but a little more transference from the first to the last part of the stroke would be advantageous. Wire-drawing would certainly, in some degree, lower the points b,b'.

In the low-pressure cylinder, the pressure transferred is a little too great. Some modification of proportions would improve both diagrams; but it might not be possible to combine in one engine the best conceivable result in each cylinder. The lines $g\,h\,i, j\,k\,l$, show the divisions between mid stroke and end quadrants.

Fig. 23. This is similar to Fig. 22, but with the ratio of volume in the two cylinders so modified as to make the power developed in them nearly equal, which is, probably the best arrangement. The circle, equal in radius to half-stroke and to mid-stroke pressure, is introduced for reference.

It represents rotative effect with uniform horizontal pressure on the crank pin throughout the revolution.

Fig. 24. This is simply Fig. 19 drawn on one-half the horizontal scale (but this relation may be changed in reducing), and reduplicated, so as to represent an entire revolution. It therefore corresponds, for 12-fold expansion in a single cylinder, with Fig. 22 for two cylinders and the same expansion.

Figures 21, 22, 23, 24, & 25, are additional to those exhibited at the annual meeting of the American Society of Mechanical Engineers, although in further elucidation of the subject, and for the most part embraced in my original purpose.

This article has grown to such length, in spite of my efforts at condensation, that I am compelled to suppress much that might serve to clear up points which may be left obscure. The best result I can hope for from this communication is that it may provoke discussion, and so be the instrument, however humble, of eliciting clearer views of truth.

Machinists' and Engineers' Supplies.

NEW YORK, Dec. 9, 1880.

The Supply market still remains in a healthy condition, and the probability is that manufacturers will occupy as little time as possible this year in taking stock and making repairs. The outlook for a good business year after the holidays is excellent.

We understand that the manufacturers of iron pipe are to hold a meeting this week, with a view of a combination which may tend to advance prices slightly.

Iron and Metal Review.

NEW YORK, December 9, 1880.

The condition of the pig iron market remains unchanged since our last report, and prices also remain as follows: Foundry No. 1, $25; Foundry No. 2, $31, Grey Forge. $20, Old rails are still held firmly at $26.50. There are no changes reported either in the condition of the market or for prices of manufactured iron.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following to-day.

The metal market is steady, business confined to jobbing sales. Pig Tin, nominally £91 10s. in London; $20 in Singapore. We quote Spot Tin, —, Banca 25c.; Malacca and Straits 21c. and up; Billiton and Australian 20¾c. and up; "Lamb & Flag," 20⅝c. and 20¾c. Pig Lead dull and not strong, 4¾ to 5c., as to lots. Antimony, 15c to 16c. as to brand. Spelter, prime Western, 5¼c. "Bertha," pure, 8¼c.; Solder, No. 1, 11½c.; "Half and Half, "13½c.; Bismuth $2.50 to $3.00.

WANTED.

Parties desiring a competent man to superintend the erection of engines or machinery, address J. F. Kingsley, Box 777, Owego, Tioga Co., N. Y.

Wanted by the Southwark Foundry and Machine Co., Philadelphia, a number of first-class Fitters on Engine Work.

Situation Wanted.—By a good mechanic with large experience, is a good designer for general and special machinery and tools. Has held important positions as manager for twenty years, can give best references as to character and ability. Address Mechanic, 72 Orange Street, Newark, N. J.

An experienced draughtsman desires a situation, or would travel for a manufacturing firm. Refer to present employers. With a good firm would accept moderate pay. Address, Draughtsman, care AMERICAN MACHINIST, 96 Fulton St., N. Y.

Wanted.—An assistant engineer fully competent to take charge of Engines, Pumps and Boilers (about 850 H. P.) of a manufacturing establishment in New York. Must understand Condensing and Non-Condensing engines. Address, Edwin G. Roan, care American Machinist Publishing Co., 96 Fulton St.

Wanted.—A partner with from $1500 to $2000 in the Foundry and Machine business. One of the best locations in Iowa. A young man preferred. For further particulars address Sac City Iron Foundry, Sac City, Sac Co., Iowa.

WATSON'S PATENT PORTABLE FORGE.
Light, Compact, Durable, Cheap.

WILLIAM COOKE (Successor to COOKE & BIGGS)
6 CORTLANDT ST., NEW YORK.
Agent and Dealer in General Machine Supplies,
Send for Price List.

WOOD-WORKING MACHINERY.
☞ Universal Wood Workers, Planing, Matching, Moulding, Band and Scroll Sawing Machines, etc.
BENTEL, MARCEDANT & CO.,
HAMILTON, OHIO, U. S. A.

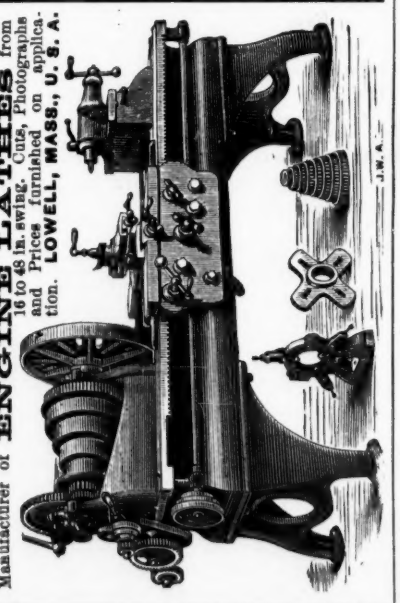
T. NEW'S PREPARED ROOFING.
For steep or flat roofs. Applied by ordinary workmen at one-third the cost of tin. Circulars and samples free. Agents Wanted. T. NEW, 38 John Street, New York.

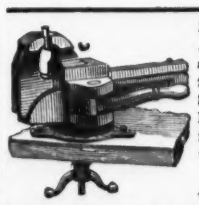
CHAS. G. LUNDELL,
No. 7 Exchange Place,
BOSTON,
MASS.
REPRESENTING
SWEDISH IRON
EKMAN & CO.
GOTHENBURG,
SWEDEN.

Machinists' Tools Wanted.
Best modern Tools, new or second hand, Wood's Automatic Bolt Cutter, with centers, or others of equal merit, Shaping Machine or Compound Planer-say 15 inch, Pulley Lathe to swing 4 or 5 ft., Traverse Drill for Steam Engine, cylinders up to 20 inch by 3 ft. say, Radial Drill, say 3 to 4 ft. overreach, Engine Lathes, say 5 to 10 ft. bed, or would buy out a good Machine Shop of Tools.
GEO. T. McLAUTHLIN & CO.,
120 Fulton St., Boston.

BOOKS FOR ENGINE BUILDERS.
A practical treatise on the Steam Engine, containing Plans and Arrangements of Details for Fixed Steam Engines, with Essays on the Principles involved in Design and Construction.
By ARTHUR RIGG, Engineer.
Illustrated with 96 Plates and many Wood Engravings.
Cheap edition, bound in Cloth, $10.00.
Our descriptive catalogue of books for mechanical engineers, and list of machine drawing copies sent free by mail on application.
E. & F. N. Spon, 446 Broome St., N. Y.

GEO. W. FIFIELD,
Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.
LOWELL, MASS., U. S. A.





STEPHENS' PATENT PARALLEL VISE and attachments, adapted to every variety of work from Jewelers' to Locomotive Shops. It opens further, holds firmer, is heavier and more durable than any other vise. For sale by the trade.
Stephens' Patent Vise Co.
41 Dey St., New York, U. S. A

KEARNEY & FOOT
Office, No. 78 Chambers Street, N. Y. — Full Weight Hand-Cut Files. — Manufactory, PATERSON, N. J.

The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

Messrs. KEARNEY & FOOT, Brooklyn, N. Y., May 24th, 1877.
Gentlemen:—We have used your Files, more or less, for several years, and we take pleasure in saying that both the new and re-cut Files have given entire satisfaction. Yours truly,
BLISS & WILLIAMS.

FARREL FOUNDRY AND MACHINE CO.
JAS. D. FOOT, Esq., Waterbury, Conn., Nov. 8th, 1878.
Dear Sir:—Please forward the order for Files given you a few days since.
Your Files have been uniformly satisfactory to us. Yours respectfully,
FARREL FOUNDRY & MACHINE CO., E. C. LEWIS, Ag't.

We print instructions on the use of Files, and also give the diameters of round and square Files from 3 to 16 inches. They are on card board, 10x12 in., and are intended to be put up in the shop for the men to read. We are pleased to mail them to any manufacturer on receipt of the necessary 6 cents postage.
Respectfully, KEARNEY & FOOT.

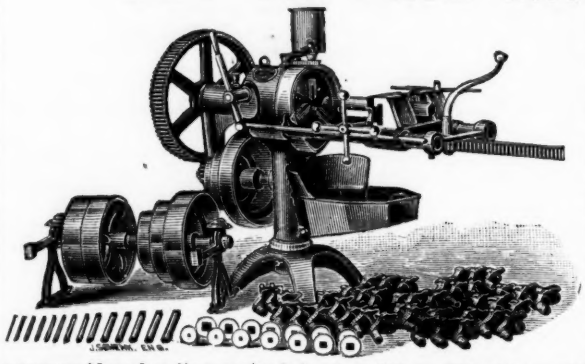
MAHONY CORRUGATED GRATE BAR.
For Steam Boilers and Furnaces.
Free Circulation with 50 Per Cent. Air Space. Openings suitable for Furnace Coal, Screenings, and all kinds of Waste Fuel.
Used by the principal manufacturers throughout New England and the West.
JAMES MAHONY, 5 Bowling Green, New York.

MORSE TWIST DRILL & MACHINE COMPANY,
NEW BEDFORD, MASS.
Sole Manufacturers of
MORSE PATENT STRAIGHT-LIP INCREASE TWIST DRILL,

Solid and Shell Reamers,
BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS,

Drills for Coes, Worcester, Hunter and other Hand Drill Presses. Drill Grinding Machines, Center and Adjustable Drill Chucks, Taper Reamers, Milling Cutters, and Special Tools to order.
All Tools Exact to Whitworth Standard Gauges.
GEO. R. STETSON, Sup't. EDWARD S. TABER, Pres't and Treas.

HOWARD IRON WORKS, BUFFALO, N. Y.
MANUFACTURERS OF
Schlenker's Revolving-Die Bolt Cutter
AND
NUT TAPPING MACHINE.



OUR NEW REVOLVING-DIE MACHINE is now recognized by practical machinists to be the perfection of a Screw Cutting Machine, and we now challenge the world to produce its equal. It possesses many advantages over any competitor. The dies are opened automatically when the desired length of thread has been cut on the bolt, and are closed by the lever, or automatically, as shown in the cut of the machine. It can be changed from one size to another in less than a minute without removing a bolt or pin. It does not require skilled labor, but can be operated by any competent boy. The dies are arranged to open and close automatically, therefore do not require the constant attention of the operator. It is a very rapid worker, its capacity being from 3000 to 3500 ⅝ bolts with 1¾ inches of thread per day—and larger bolts in proportion. Threads cut by these machines will not vary ½ thread in length on ten thousand bolts. The machines are simple in construction, very compact and strongly built, and are offered much below the price of any other machines capable of cutting the same sizes, and amount of work. It is adapted to cut right and left hand, V thread, square threads, and coach screws,—will take in crooked as well as straight work, and cut any length of bolt. The machines are now largely in use, and we offer them to the trade as one of the most complete machinists' tools in the market. Every machine is warranted as recommended.
HOWARD IRON WORKS, Buffalo, N. Y.
Illustrated Catalogue sent on Application.

NOW READY!
EXTRACTS FROM CHORDAL'S LETTERS.
12mo. 320 pages. Cloth. $1.50, postpaid.
Containing Over 40 Original Humorous Illustrations.
A wide range of mechanical topics treated in a lively, instructive and masterly manner. Will be appreciated by young and old alike, and especially by those interested in mechanical pursuits.
PUBLISHED BY
AMERICAN MACHINIST PUBLISHING CO.
96 Fulton Street, New York.

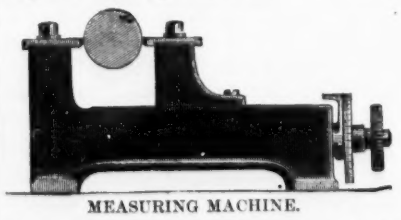
USEFUL BOOKS
Relating to Casting and Founding, Electricity, Electric Light, Engineering, Drawing, Manufacture of Gas, Heat, Indicator Diagram, Link Motion, Mechanics, Screw Cutting, Slide Valve, Steam Boilers, Steam Engines, Steel, Turning, Wire Gauge, Workshop Receipts. Descriptive Catalogue sent promptly on application.
E. & F. N. Spon, 446 Broome St., N. Y.

A. ALEX. POOL & CO.
NEWARK, N. J.
Manufacturers of
Combined Lathes and Milling Machines
FOR TOOL MAKERS' USE, also
Universal Milling Machines, Grinding Machines.

BETTS MACHINE CO., WILMINGTON, DEL.
MANUFACTURERS OF
STANDARD GAUGES,
MEASURING MACHINES & ADJUSTABLE REAMERS.

STANDARD GAUGE.
Any size from ¼ in to 6 in.

CORRECTIVE GAUGE.
The disks are ground separately. Any combination of sizes can be made.



MEASURING MACHINE.
Sizes, 0 to 4 in., 0 to 12 in., 0 to 24 in. Can indicate to $\frac{1}{10000}$ of an inch.

ADJUSTABLE REAMER.
Any size from ½ in. to 2½ in.
Size Maintained by Blade Adjustment.
Will Outlast the Solid Reamer.
Shank Ground to Standard Size.

KEEP SIZES RIGHT and thus CHEAPEN PRODUCTION.
SEND FOR CIRCULAR.

NICHOLSON FILE CO.

SOLE MANUFACTURERS OF

FILES AND RASPS

HAVING THE INCREMENT CUT.

Also, FILERS' TOOLS and SPECIALTIES.

"Nicholson File Co's" Files and Rasps.
"Double Ender" Saw Files.
"Slim" Saw Files.
"Racer" Horse Rasps.
Handled Rifflers.
Machinists' Scrapers.
File Brushes, File Cards.
Surface File Holders.
Vice File Holders.
Stub Files and Holders.
Improved Butchers' Steels.

Manufactory and Offices at PROVIDENCE, R. I., U. S. A.

Branch Office,
46 & 48 WEST LAKE STREET,
CHICAGO, ILL.

BRADLEY'S CUSHIONED HELVE HAMMER.

Awarded first premium, Silver Medal at American Institute Fair, 1873, Cincinnati Industrial Exposition, 1874, and the Diploma of Honor and Grand Medal of Merit at the Centennial Exhibition, in 1876,

Being the highest award given any goods of their class in America or Europe.

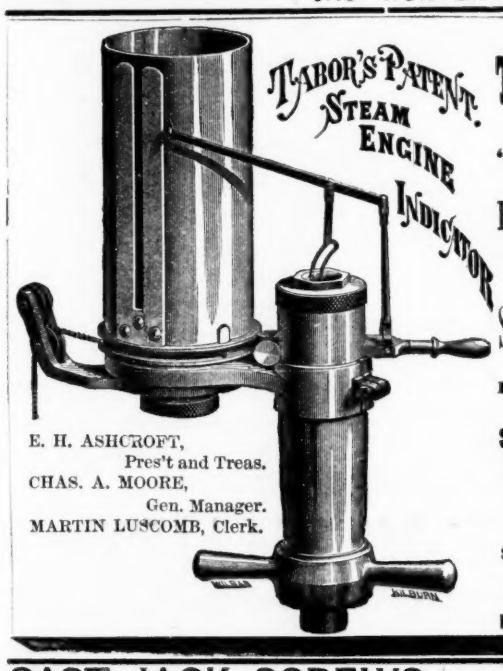
IT HAS MORE GOOD POINTS, LESS COMPLICATION,
MORE ADAPTABILITY, LARGER CAPACITY,
DOES MORE AND BETTER WORK, TAKES LESS POWER,
COSTS LESS FOR REPAIRS
THAN ANY HAMMER IN THE WORLD.

Guaranteed as represented. (Established 1832.)

BRADLEY & COMPANY, Syracuse, N. Y.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLNGS,

JAS. HUNTER & SON. North Adams. Mass.



E. H. ASHCROFT,
Pres't and Treas.
CHAS. A. MOORE,
Gen. Manager.
MARTIN LUSCOMB, Clerk.

ESTABLISHED 1851.

The Ashcroft Manufacturing Co.

Successors to E. H. ASHCROFT,
"Original Steam Gauge Works."
THE E. H. ASHCROFT
Improved "Bourdon" Steam Gauges.
Sole Owners and Manufacturers of
TABOR'S PATENT
STEAM ENGINE INDICATORS.
Specially adapted to
Indicating High Speed Engines and Locomotives.

STEAM AND WATER GAUGES,
Railway, Steamship & Machinery Supplies.
WAREROOMS:
Nos. 51 & 53 Sudbury St., and
8, 10, 11, 12 & 14 Bowker Street,
BOSTON, MASS.
Factories, BOSTON & LYNN.

CAST JACK SCREWS,

With perfect, seamless thread, and hard wearing surface. Special mixture of tough iron. Superior to wrought iron in many respects, and **much cheaper.**

N. B.—Our No. 2 "Handy Bell Jack," 8x1¼ inch, **Price, $2.00,** (see Cut) has lifted 10 tons

Send for circular.

SEEGER MF'G CO.

MAKERS OF

Press, Stool & Bench Screws,

CLAMPS, &c.

Box 878. Springfield, Mass.

Machinists, Tool Makers,

AND OTHER CONSUMERS OF CASTINGS,

who do not make their own, may do well by writing us for prices. Our Foundry is among the best, and its capacity being several tons per day more than consumed in our machine shop, we will do work for others at moderate prices and guarantee satisfaction.

We have patterns for Engine Fly Wheels and Pulleys of all sizes up to 8 feet diameter, any desired width, from which we will make castings, turn and bore same on best terms. State particulars and address us or visit our works,

CHRISTIANA MACHINE CO.

CHRISTIANA, Pa.

AKRON IRON COMPANY,

AKRON, O.

SOLE MANUFACTURERS OF

Patent Hot Polished Shafting.

This shafting commends itself to the trade generally as superior to any shafting ever before introduced to the market for the following reasons, viz.:

1st.—It is perfectly straight and round.

2d.—It can be rolled accurately to any desired gauge.

3d.—It has the beautiful blue finish of Russia Sheet Iron, rendering it less liable to rust or tarnish than shafting of the ordinary finish.

4th.—It will NOT SPRING OR WARP IN KEY SEATING like most of the other manufactured shafting sold in the market, and, as a consequence, is admirably adapted for LINE AND COUNTER SHAFTING.

5th.—The surface is composed of MAGNETIC OXIDE OF IRON, forming a superior journal or bearing surface.

6th.—It is made of superior stock.

Sizes made from ¾ inch to 3 inches, advancing by sixteenths, and from 3 inches to 4 inches, advancing by eighths. Price lists, with references and other information, furnished on application to us.

Or to our Agent,

AKRON IRON CO., Akron, Ohio.

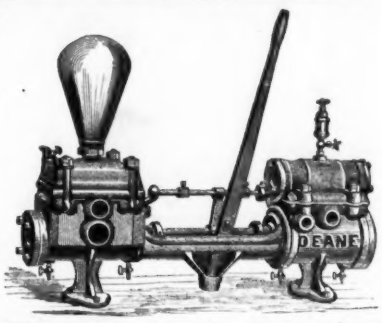
E. P. BULLARD, 14 Dey Street, New York City,

General Agent for N. Y. City and other Eastern States.

DEANE'S PATENT STEAM PUMPS

FOR SIMPLICITY OF MECHANISM
—AND—
EFFICIENCY IN OPERATION

THEY ARE UNEQUALED.



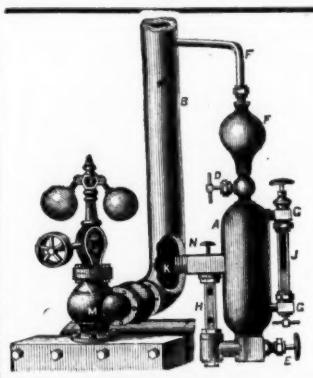
MANUFACTURED BY THE

DEANE STEAM PUMP CO.

HOLYOKE, MASS.

WAREROOMS: 92 and 94 LIBERTY STREET, NEW YORK, 7 OLIVER STREET, BOSTON.

Send for Illustrated Catalogue and Price List.



JAMES BEGGS & CO.

Practical Mechanical Engineers,

MACHINISTS AND DRAUGHTSMEN,

MANUFACTURERS OF

Railway and Machinists' Supplies,

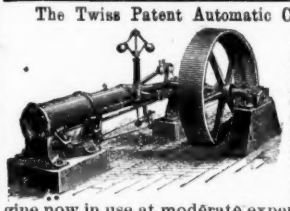
Warerooms, 8 Dey St., New York.

SOLE AGENTS FOR

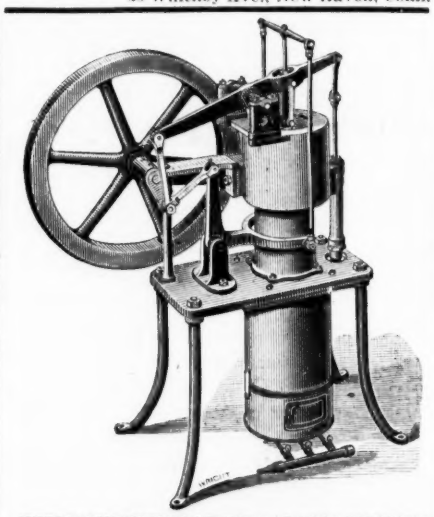
Detroit Lubricator, the Excelsior Tube Scraper, Gardner Governor, Rowland Engine.
Selling Agents for Roots' Patent Rotary Blower.

Illustrated Catalogue and Price List on application.

The Twiss Patent Automatic Cut-off Engine



is a first-class Engine in every respect. The valve gear is of the disengaging type, is exceedingly simple, accessible and durable. Cylinders with this cut-off can be placed on any engine now in use at moderate expense and will save from 30 to 50 per cent. in fuel over the plain slide valve and throttle governor. Also, Vertical and Yacht Engines. NELSON W. TWISS,
25 Whitney Ave., New Haven, Conn.



ERICSSON'S NEW PATENT CALORIC PUMPING ENGINE is specially intended for domestic use in lifting and forcing water from wells and cisterns, or from Croton pipes, to tanks on upper floors of buildings in city or country.

This pumping engine is entirely safe, no steam being employed, and is not liable to derangement.

All kinds of fuel will answer for this engine, but coal-gas is preferable, the consumption being only 15 cubic feet per hour. Besides gas is handier and cleaner than coal or other combustibles. Servant girl can operate it!

Price for 8-inch cylinder, pumping 350 gallons per hour 50 feet: With gas furnace, - $260 00
With coal furnace, - 275 00
Price for 6-inch cylinder, pumping 200 gallons per hour 50 feet: With gas furnace, - $210 00
With coal furnace, - 220 00

Manufactured by the Delamater Iron Works.
C. H. DELAMATER & CO., Proprietors,
No. 10 CORTLANDT ST., N. Y. CITY.

C. W. LeCOUNT,

South Norwalk, Connecticut,

Manufacturer of

LeCount's Improved Steel Dog

With hardened Steel Screws turned in the Lathe.

PRICES.

No. 1....	¾ in...	$	.40
" 2....	½ "		.50
" 3....	¾ "		.60
" 4....	1 "		.70
" 5....	1¼ "		.85
" 6....	1½ "		.95
" 7....	1¾ "		1.10
" 8...	2 "		1.20

SMALL SET, $6.30.

No. 9..	2½ in....		1.40
" 10..	3 "		1.60
" 11..	3½ "		1.80
" 12..	4 "		2.00

FULL SET, $13.00.

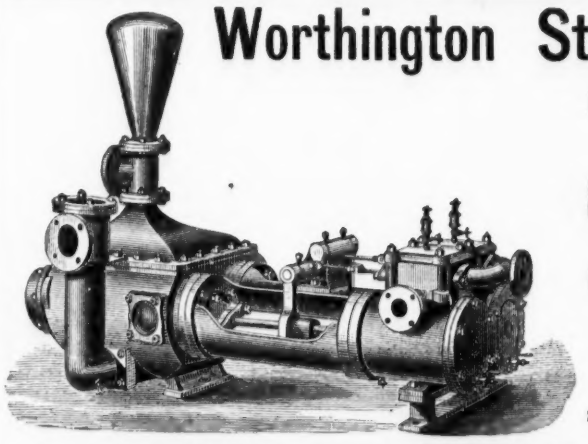
COLUMBIA BICYCLE.

Bicycle riding is unsurpassed as a method of traveling, whether for speed, sport, or the renewal of health. The practicability of the machine has been thoroughly tested, and satisfactorily proved beyond question. Thousands are in daily use, and the number is rapidly increasing. The exercise is recommended by the medical profession as most beneficial to health, bringing into action almost every muscle of the body. Send 3c. stamp for illustrated catalogue containing price list and full information.

THE POPE MFG. CO.

47 Summer St., Boston.

Worthington Steam Pump.



For all Purposes and of all Sizes.

SPECIAL PATTERNS

FOR

Railway Water Stations, Oil Pipe Lines, Hydraulic Elevators, etc.

SEND FOR LATEST CIRCULAR.

HENRY R. WORTHINGTON,

239 BROADWAY, NEW YORK. 83 WATER ST., BOSTON. 709 MARKET ST., ST. LOUIS.

SUPERIOR SUBSTITUTE FOR WOOD ENGRAVING.

J. C. MOSS, Pres. and Sup't. M. A. MOSS, Treasurer. J. E. RAMSEY, Secretary.
R. B. MOSS, Assist. Sup't. H. A. JACKSON, Assist. Sec.

MOSS ENGRAVING CO

INCORPORATED (MOSS'S NEW PROCESS.) APRIL 2, 1880

535 PEARL STREET, COR. ELM, NEW YORK.

LARGEST ESTABLISHMENT OF THE KIND IN THE WORLD.

ENGRAVINGS OF PORTRAITS, BUILDINGS, LANDSCAPES, MACHINERY, MAPS, ORNAMENTAL LETTERING and GENERAL ILLUSTRATIONS FOR NEWSPAPERS, BOOKS, CATALOGUES, etc. **Much cheaper than Wood Cuts.** *Mr. J. C. Moss, the inventor of the Moss Process of Photo-Engraving, in withdrawing from the Photo-Engraving Co., 67 Park Place, has retained for himself all improvements made and used by him in Photo-Engraving since May, 1872.* Send green stamp for Illustrated Circular. Send copy for estimate. Please mention this paper.

Union Manufacturing Co.

NEW BRITAIN, CONN.

THE SKINNER COMBINATION CHUCK.

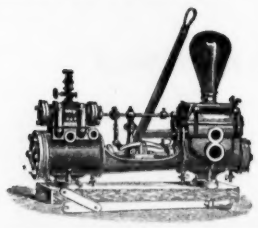
This Chuck is **Universal, Independent** and **Eccentric,** and was patented June 24 and November 18, 1879.

We are determined that this Chuck shall be the best in the market, believing that our customers do not want an inferior article, and with the improvements, as shown in the cuts, we have no hesitancy in saying **ours is the best Chuck manufactured,** and **we guarantee every Chuck of this make perfect in every respect.**

All parts will be made **interchangeable,** and in case repairs become necessary, we can furnish the part needed without the Chuck being returned to us, saving much time and expense, **especially on goods sold out of the country.**

We can fill promptly orders for 4, 6, 9 and 12 inch Chucks, with either three or four jaws. Orders for the other sizes will be filled with but little delay. **Warehouse, 96 Chambers Street, New York.**

KNOWLES' IMPROVED STEAM PUMPS,



THE STANDARD!

Steam Pumps for Every Possible Service.

SEND FOR ILLUSTRATED CATALOGUE.

KNOWLES STEAM PUMP WORKS,

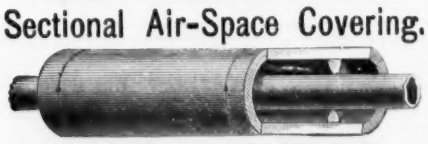
86 Liberty Street, NEW YORK. | *44 Washington Street,* BOSTON.

The Raymond Mfg. Co.'s

PATENT

Non-Conductor Coverings for STEAM PIPES AND BOILERS.

Sectional Air-Space Covering.



American Ash Felting.

Awarded Medal and Diploma at Centennial Exposition.

HAIR FELT & PLASTIC CEMENT.

FACTORY: 642 W. 52d Street, | OFFICE: 108 Liberty Street, NEW YORK.

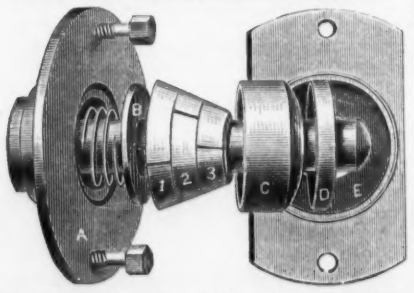
☞ Send for Circulars.

U. S. METALLIC PACKING CO.

MANUFACTURERS OF

SELF-ADJUSTING STEAM PACKING

FOR MARINE AND STATIONARY ENGINES.



82 Canal Street, BOSTON. | 247 West 38th St. NEW YORK.

GEO. H. BARRUS,

EXPERT ENGINEER,

87 MILK ST., BOSTON.

May be consulted on matters relating to the generation and use of STEAM and the arrangement of New Works.

Expert Tests

made on ENGINES, BOILERS, and STEAM PUMPING MACHINERY.

E. E. GARVIN & CO.

Manufacturers of

Milling Machines, Drill Presses,

No. 4 Milling Machine.

Hand Lathes, Tapping Machines, Cutter Grinders and Wood Planers. Milling Cutters, all shapes and sizes. Gear Cutting and Milling in all its branches.

139-143 CENTRE ST. Cornell's B'ld'g NEW YORK.

☞ Send for illustrated Catalogue.

E. LYON & CO.

Hyd. Claw. Jack.

470 Grand St.

NEW YORK.

Sole Manufacturers of

Lyon's Patent Punches and Shears.

For Round, Square and Flat Iron.

Hydraulic Presses,

For Special and General Uses.

Hydraulic Pumps,

For Driving Presses.

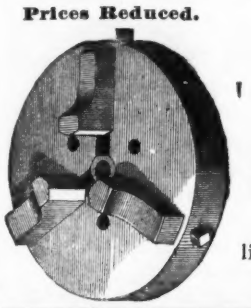
Hydraulic Jacks and Punches.

Polishing and Buffing Machinery.

CIRCULARS ON APPLICATION.

The E. HORTON & SON CO.

Prices Reduced.



Windsor Locks, Conn.

MANUFACTURERS OF

THE HORTON LATHE CHUCK,

BOTH

INDEPENDENT AND UNIVERSAL,

ALSO THE

Horton Car Wheel Chuck.

FEBRUARY 1st, 1880.

From this date a discount of 25 per cent. will be made from the list price of The Horton Lathe Chuck,

Soliciting your orders, we are, respectfully yours,

Send for Price List. THE E. HORTON & SON CO.

JARVIS PATENT FURNACE

FOR SETTING STEAM BOILERS.

Economy of Fuel, with increased capacity of Steam Power.

The same principle as the SIEMENS' PROCESS OF MAKING STEEL, utilizes the waste gases with hot air on top of the fire.

Will burn all kinds of waste fuel without a blast, including screenings, wet peat, wet hops, sawdust, logwood chips, horse manure, &c.

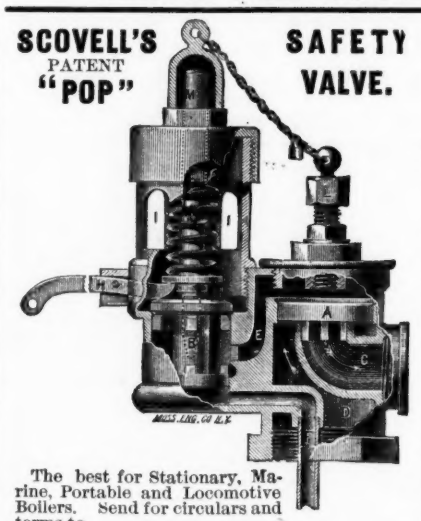
Send for Circular.

A. F. UPTON, General Agent,

7 Oliver St., (P. O. Box 3401) Boston, Mass.

BARKER & BERTON, New York Agents, 422 East 23d St.

SCOVELL'S PATENT "POP" SAFETY VALVE.



The best for Stationary, Marine, Portable and Locomotive Boilers. Send for circulars and terms to

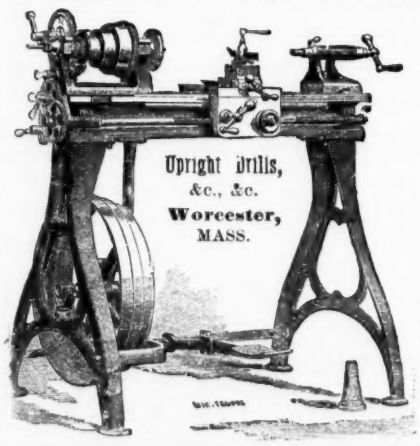
The Hancock Inspirator Co.

34 Beach Street, Boston, Mass.

PRENTICE BROTHERS,

Manufacturers of

Machinists' Tools, Engine Lathes,



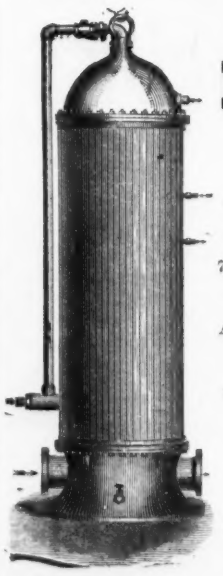
Upright Drills, &c., &c.

Worcester, MASS.

STRONG'S PATENT

Feed Water Heater and Filter,

Absolute Preventive of Incrustation.



MANUFACTURED BY

I. P. MORRIS CO.

PHILADELPHIA.

SALES AGENTS:

KELLY & LUDWIG, 720 to 724 Filbert Street, PHILADELPHIA,

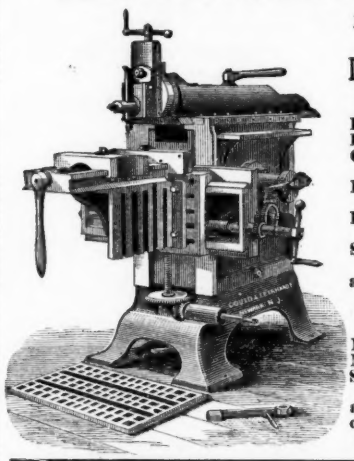
And 6 Cortlandt Street, NEW YORK.

WALWORTH MF'G CO. Kilby Street, BOSTON.

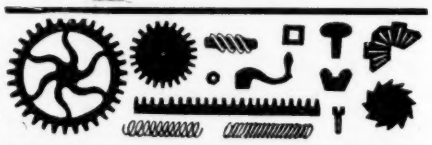
FRANK H. POND, 709 Market Street, ST. LOUIS.

E. GOULD & EBERHARDT,

97 to 113 N. J. R. R. Ave., Newark, N. J.



Builders of Lathes, Shapers, Planers, Bolt and Gear Cutters, Drawing, Drill, Drop, Foot, Screw, Power and Bank Note Printing Presses, Mortising Machines, Stone Crushers and Special Machinery.



Small Tools of all kinds, GEAR WHEELS, parts of MODELS, and materials of all kinds. Catalogues free. GOODNOW & WIGHTMAN, 176 Wash'ton St., Boston, Mass.

Dead Stroke

POWER HAMMERS

Are superior to all others for Forging and Die Work. Over 500 now in use.

Manufactured by

PHILIP S. JUSTICE,

14 N. 5th St., Philadelphia, Pa.

BEECHER & PECK,

(Successors to Milo Peck),

Manufacturers of

PECK'S PAT. DROP PRESS.

Peck's Drop Lifter the only one that has its parts cushioned,

Send for illustrated Catalogue.

157 Temple St., New Haven, Conn.

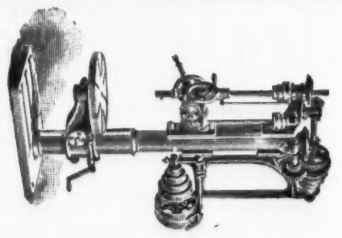
WOOD & DRAKE,

71 Rutger St., New York City.

Machinery Bought, Sold and Exchanged.

A general assortment of Engines, Boilers, Pumps, &c. (both new and second-hand) constantly on hand.

Parties having Machinery they wish to sell will do well to inform us.



New Haven Manf'g Co.

NEW HAVEN, CONN.

Lathes, Planers, Shapers.

Patent Band Saws,

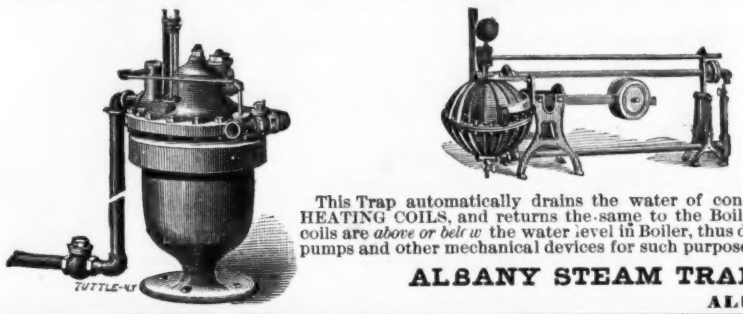
A SPECIALTY.

Pattern makers are now using Band Saws exclusively for both inside and outside sawing because it *pays*. For circulars, address

FRANK H. CLEMENT,

122 Mill Street, Rochester, N. Y.

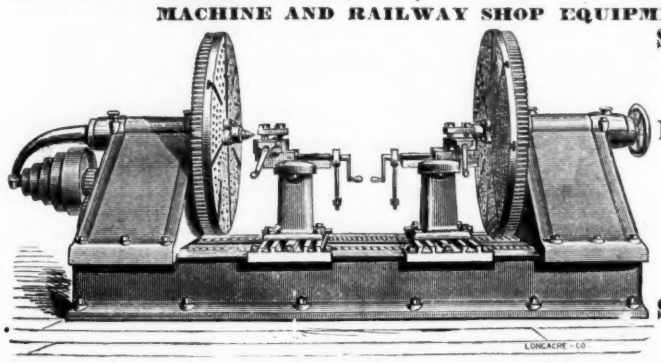
THE ALBANY STEAM TRAP.



This Trap automatically drains the water of condensation from HEATING COILS, and returns the same to the Boiler, whether the coils are *above or below* the water level in Boiler, thus doing away with pumps and other mechanical devices for such purposes. Address

ALBANY STEAM TRAP CO.,
ALBANY, N. Y.

WILLIAM SELLERS & CO., - - - PHILADELPHIA.
MACHINE AND RAILWAY SHOP EQUIPMENTS.



Shafts, Couplings, Hangers, Pulleys, Mill Gearing, Etc. Lathes, Planers, Drills, Shapers, Bolt Cutters, Etc.

Railway Turntables and Pivot Bridges. Gifford Injectors, Sellers' Improvements.
NEW PATTERNS. SIMPLE, EFFECTIVE.
NEW YORK OFFICE, 79 LIBERTY STREET.

R. HOE & CO.
Printing Press,
Machine and Saw
MANUFACTURERS,
Grand, Sheriff, Broome & Columbia Sts.
29 & 31 Gold Street.
Principal Office, 504 Grand St., cor. Sheriff,
NEW YORK.

P. BLAISDELL & CO.
MANUFACTURERS OF
Machinists' Tools,
Worcester, MASS.

WILEY & RUSSELL MF'G CO.
GREENFIELD, MASS.
Lightning Screw Cutting Machinery and Tools.

SEND FOR ILLUSTRATED PRICE LIST.

POOLE & HUNT, BALTIMORE.
MANUFACTURERS OF
THE POOLE & HUNT LEFFEL TURBINE
WATER WHEELS,
MACHINE MOULDED
MILL GEARING,
SHAFTING, PULLEYS AND HANGERS,
STEAM ENGINES AND BOILERS,
MIXERS FOR FERTILIZERS AND CHEMICALS.

CARMICHAEL & EMMENS,
130, 132 & 134 Cedar Street, New York,
DEALERS IN
Iron and Steel Boiler Plate,
LAP WELDED BOILER TUBES, &c., &c.
Agent for Otis Celebrated Cast Steel Boiler Plates; the Coatesville Iron Co.; Pottstown Iron Co.; the Laurel Rolling Mills and Union Tube Works.
Wrought Iron Beams, Angles, Tees, Rivets, &c.

F. W. MOSS,
80 John Street, New York,
(Successor to Joshua Moss and Gamble Bros.,)
Steel and Files,
HAMMERS, ANVILS, VISES AND BLACKSMITHS' TOOLS.
WARRANTED CAST STEEL,
Specially adapted for Dies, Punches, Turning Tools, Drills, &c. Also

IMPROVED MILD-CENTRED CAST STEEL

For Taps, Reamers, Milling Tools, &c.

Warranted not to crack in hardening Tools of any Size.

CROSBY'S STEAM ENGINE INDICATOR.

CROSBY STEAM GAGE & VALVE CO.
J. H. MILLETT, Pres't.
GEO. H. CROSBY, Sup't. GEO. H. EAGER, Treas
Sole Proprietors and Manufacturers of
CROSBY'S
Adjustable "Pop" Safety Valve,
Self-Regulating Reducing Valve.
Improved Steam Pressure Gage.
Self-Closing Water Gage.
Improved Steam Engine Indicator.
Sole Manufacturers and General Agents for
The "VICTORY" Steam Cylinder Lubricator.
And all instruments of this class. Send for Illustrated Catalogue.
Cor. Milk & Batterymarch Sts., Boston.

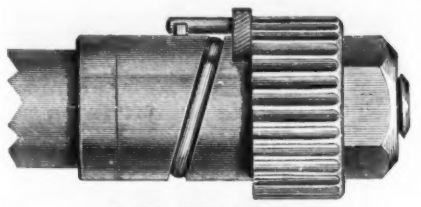
"BELTOLEUM,"
THE BEST PREPARATION FOR LEATHER BELTING IN THE MARKET.

Makes it soft and pliable, producing no sponginess. Contains no gummy or fatty oils that soon become rancid, thereby causing leather to dry and crack. Nor does it contain tallow, resin, acid or residuum, but is a harmonious union of the best ingredients of the

Animal, Vegetable & Mineral Kingdom.

Being an oil, it is always ready for use, and may be applied when belts are running, and will keep them in fine condition.
It is clean to use, as it penetrates the pores and leaves nothing on the surface to collect dust and dirt.
Sent to responsible parties on trial when desired.
Send for circular. Put up in Cans and Barrels.

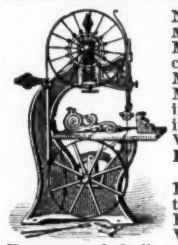
A. H. DOWNER,
Inventor and Sole Manufacturer,
Office, 17 Peck Slip, New York.



NEW
Mechanical Movement
Patented March 9th, 1880.
A positive and perfectly noiseless substitute for Pawl and Ratchet.
Also adapted as a Safety Brake or Lock on Hoisting Machinery, the Steering Apparatus of Ships, or in any place where it is desirable to resist any application of power on a shaft, from either direction, while at the same time it may be easily turned by the operator.
EDWARD WRIGHT & CO.
WORCESTER, MASS.

Pattern and Brand Letters.
VANDERBURGH, WELLS & CO.
Printers' and Engravers' Warehouse,
Corner Fulton and Dutch Sts.,
NEW YORK.

WOOD WORKING MACHINERY.
J. A. FAY & CO.,
BUILDERS OF
IMPROVED MACHINERY FOR WOOD CUTTING.



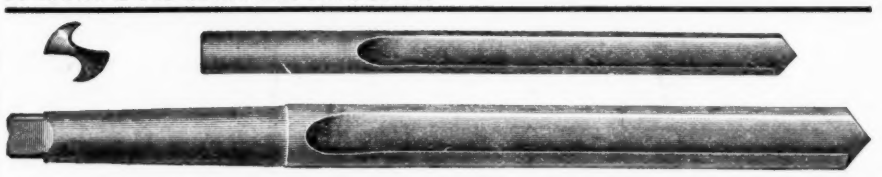
Numbering some 300 different Machines—Planing and Matching Machines, Surface Planing Machines, Molding and Tenoning Machines, Mortising and Boring Machines, Carving and Dovetailing Machines, Shafting and Friezing Machines, Horizontal and Vertical Boring Machines.
Improved Variety & Universal WOOD WORKERS.
Band, Scroll, Ripping and Cutting-off Saws, Band and Circular Resawing Machines, Spoke and Wheel Machinery, Shafting, Hangers and Pulleys, etc., etc. Original in design, simple in construction, perfect in workmanship, saves labor, economizes lumber, and its productions are of the highest standard of excellence. ***Send for Circulars and Prices.***
J. A. FAY & CO., Cincinnati, Ohio, U.S.A.

Steam Pumps,
AIR COMPRESSORS,
Friction Hoisting Engines,
Vacuum Pumps & Condensers,
GENERAL MACHINERY
Steam Engines.
Capacity to bore Cylinders 110 Inches Diameter, and turn Fly Wheels of 24 feet.
THE NORWALK IRON WORKS CO.
South Norwalk, Conn.

WE CHALLENGE THE WORLD FOR ITS EQUAL.
RUFFNER & DUNN,
Schuylkill Falls, Philadelphia.

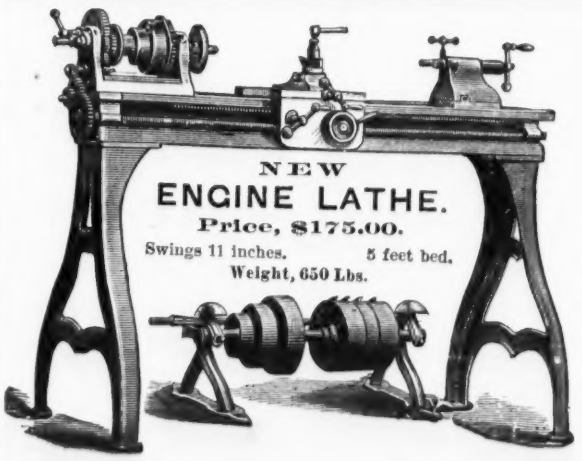
Patentees and sole manufacturers of the Excelsior Steel Tube Cleaners. $1.00 per inch. Most liberal discounts to dealers. Send for circular.

W. C. YOUNG & CO.
Manufacturers of
Hand Lathes,
Foot Power Lathes,
Slide Rests, &c.
WORCESTER, MASS.



THE FARMER LATHE-DRILL AND TOOL CO.
LEOMINSTER, MASS., U. S. A.
MANUFACTURERS OF
Drills and Machinists' Small Tools.
Attention given to making Drills for special purposes, **either straight flute, or twisted** Also, manufacturers of the **NEW PATENT LATHE-DRILLS,** to which we would call the attention of those who work in Copper, Brass, and the softer metals. For price list and further information address as above, or
L. B. RUSSELL, Gen. Agent, 96½ Summer St., Boston, Mass.

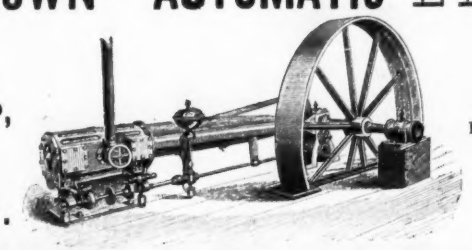
SAMUEL A. BECKETT, Mechanical Engineer. FREDERICK H. McDOWELL, Engineer of Mines.
Beckett & McDowell,
MINING AND MECHANICAL ENGINEERS
AND MANUFACTURERS OF
Steam Engines and Mining Machinery,
Office, 17 COURTLANDT ST., NEW YORK.
Works at Arlington, N. J.



A. F. Prentice & Co.
Manufacturers of
Light Machinists' Tools.
Improved Upright Drills, with Lever Feed and Wheel Feed with Quick Return Motion.
Hand and Foot Power Lathes.
SLIDE RESTS.
Special Machinery and Machine Jobbing.
FOOT POWER LATHES A SPECIALTY.
54 Hermon Street,
WORCESTER, MASS.

THE "BROWN" AUTOMATIC CUT-OFF ENGINE.

UNEXCELLED FOR WORKMANSHIP, ECONOMY AND DURABILITY.



WRITE FOR PRICES AND INFORMATION.

C. H. BROWN & CO., Sole Manufacturers,
FITCHBURG, MASS.

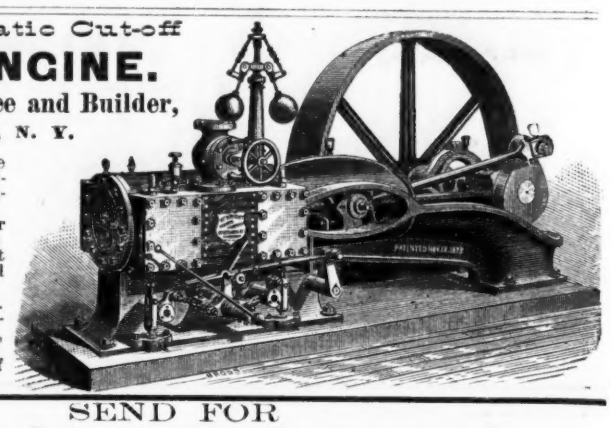
Patent Automatic Cut-off
STEAM ENGINE.
Wm. Wright, Patentee and Builder,
NEWBURGH, N. Y.

The most economical in the use of fuel, the simplest in construction, and altogether the best cut-off engine in the market.

COMPOUND ENGINES for City Water Works; also for Manufacturing purposes, &c. (Highest duty guaranteed.) Marine and Stationary Engines.

STEAM BOILERS and TANKS. Light and Heavy Forgings, Shafting, Pulleys, Hangers, Mill Work, Iron and Brass Castings, &c.

A large general assortment of Patterns on hand.



THE
LAWRENCE ENGINE,

A FIRST-CLASS AUTOMATIC CUT-OFF STATIONARY

ENGINE.

Highest Economy. *Best Workmanship at a Moderate Price.*

ARMINGTON & SIMS, - LAWRENCE, Mass.
A. F. UPTON, New England Agent, 7 Oliver Street, Boston.

SEND FOR
New Catalogue and Reduced Price List
— OF —
Lathe and Drill Chucks
Containing New Designs and Improvements.
JUST ISSUED BY
A. F. CUSHMAN, - - HARTFORD, CONN.

H. PRENTISS AND COMPANY
14 DEY STREET, NEW YORK.
Agency of

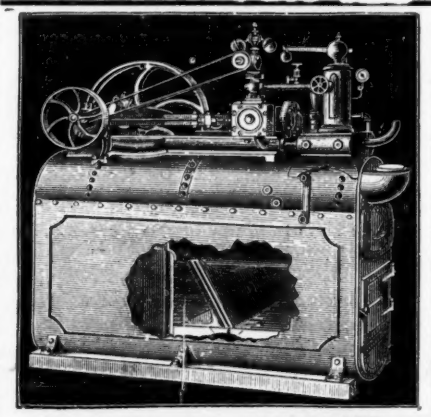
THE TANITE CO.
REYNOLDS & CO.
BILLINGS & SPENCER CO.
H. L. SHEPARD & CO., and for
THE UNIVERSAL LATHE DRILL,
BURNES PAT. DIE STOCK,
DEVERALL'S PAT. OILERS,
Etc., Etc.

THE BELMONTYLE OIL
Prevents Rust, Tarnish, &c., on Fire Arms, Machinery, Tools, Cutlery, Safes, Saws, Skates, Stoves, Hardware, &c., without injury to the polish. In use over 10 years. Highest Testimonials. Samples 50 cents, three for $1.00, sent free of expressage. Send for circular.
Belmontyle Oil Co.,
SOLE MANUFACTURERS,
150 Front Street, New York.

ANEMOMETERS OR AIR METERS
For measuring the velocity of air currents in mines, sewers, hospitals, etc. Instruments of precision used in civil and mechanical engineering imported and manufactured by
JAMES PRENTICE,
164 BROADWAY, NEW YORK.

L. B. EATON,
TOOL STORE,
Tool Chests, $6.25, $9 00 $12.00, $16.00, $22 00.
EVERY TOOL WARRANTED.
CHALLENGE SCROLL SAW, $15.00,
Also other makes. Send for Catalogue of Tools.
No. 11 North 6th Street, Philadelphia.

CHARLES MURRAY.
ENGRAVER ON WOOD.
No. 58 ANN ST.
NEW YORK.



PORTABLE AND STATIONARY
Engines and Boilers,
2½ to 15 H. P. Return Flue Boiler, large Fire Box, no sparks. Do not fail to send for circular to
SKINNER & WOOD, Erie, Pa.

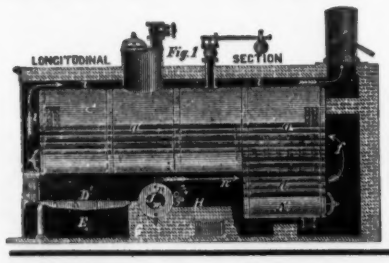
FRASSE & COMPANY,
62 Chatham Street New York,
PROPRIETORS OF THE
Briggs, & Leader, Lathes,
SOLE AGENTS FOR
ELTERICH'S TAPS AND DIES,

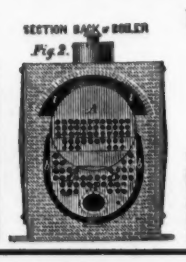
Comprising the best assortment and largest variety, of threads, from 1-16 to ¼ inch in the United States.
Send for circular.
Importers of STUBS' TOOLS, FILES, and STEEL WIRE, and GROBET FILES.
Agents for the U. S. of Rollason's Patent Steel Music Wire.
No. 0 to No. 32 (Music Wire Gauge) always in Stock.
Sole Agents for Chateau's French Emery Paper.
Fine Tools, Files, Steel Wire
Silver Solder for Brazing Band Saws,
AND SUPPLIES FOR MACHINISTS A SPECIALTY.

THE NASON MANUFACTURING CO.
DESIGNERS AND CONSTRUCTORS OF
STEAM AND HOT WATER APPARATUS.
FOR
PUBLIC BUILDINGS, HOTELS, APARTMENT HOUSES, STORES & DWELLINGS.
PARTICULAR ATTENTION GIVEN TO THE PREPARATION OF SPECIFICATIONS & ESTIMATES.
Nos. 71 Beekman and 71 Fulton Sts., New York.
BOILERS. RADIATORS. VENTILATING FANS.

STOW FLEXIBLE SHAFT CO., Limited,
Sole manufacturers for other than dental purposes of the popular
STOW FLEXIBLE SHAFTS
AND TOOLS AND MACHINES OPERATED THEREWITH.
In connection with our newly patented "Round-about Transfer" we command a whole shop from one Countershaft with a tool that is **truly portable**, either for Drilling, Boring, Emery Grinding, Polishing, Brushing, &c., &c. Send for Circular to
1505 to 1509 Pennsylvania Avenue, Philadelphia, Pa.

MONTGOMERY BOILER AND MACHINE WORKS.
WM. T. BATE & SON, East Conshohocken, PENNA.
MANUFACTURERS OF
Bate's Patent Steam Generator.





Iron Founders,
Boiler Makers AND
Machinists.

A large number of these boilers in use in the best establishments and institutions, showing **Splendid Results** in the way of economy, efficiency, durability and convenience of cleaning. We refer to parties using. Write for particulars.

KORTING'S STEAM BLAST NOZZLE
FOR INCREASING DRAUGHT IN CHIMNEYS.
And also for use in Smoke Stacks of Steam Vessels. Can be used as Steam Ventilator for Mines.
A. ALLER, 109 Liberty St., New York.
Send for Circular.

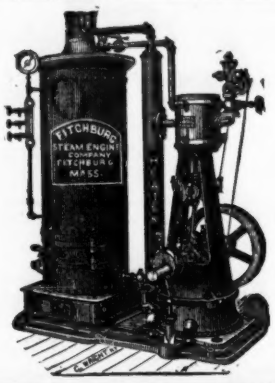
THE
HANCOCK INSPIRATOR CO.
MANUFACTURERS OF
INSPIRATORS, EJECTORS,
—AND—
GENERAL JET APPARATUS,
34 Beach Street, Boston, Mass.
35 Queen Victoria St., London, England.

D. SAUNDERS' SONS'
New Pipe-Threading Machine,
THE
I.X.L.
FOR HAND OR POWER,
Manufacturers of
Steam and Gas Fitters' Tools,
Pipe Cutting and Threading Machines for Pipe Mill Use, &c., a Specialty.
YONKERS, N. Y.
Send for Circulars.

FOR SALE.
One Regulating Cut-off Condensing Engine of 250 H. P. Also a great variety of Engines, Boilers and other Machinery, both new and second-hand. Send for Circulars.
S. L. HOLT & CO.
67 Sudbury Street, Boston.

Mechanical Books.
Send 10 cents for 96 page Catalogue of Books for Machinists and Engineers.
D. VAN NOSTRAND,
23 Murray & 27 Warren Sts., New York.

HORIZONTAL.
VERTICAL
Automatic Cut-off
ENGINES.
Yacht Engines,
Semi-Portable Engines.



STEEL AND IRON BOILERS.

All sizes to 225 horse-power.

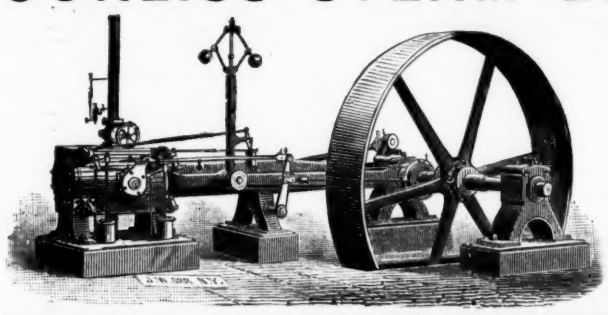
Send for pamphlet and say where you saw this.

FITCHBURG STEAM ENGINE CO.
Fitchburg, Mass.

NEW OTTO SILENT GAS ENGINE.

Working without Boiler, Steam, Coal, Ashes or Attendance.
Started Instantly by a Match, it gives full power immediately.
WHEN STOPPED, ALL EXPENSE CEASES.
No Explosions; No Fires nor Cinders; No Gauges; No Pumps; No Engineer or other attendant while running.
UNSURPASSED IN EVERY RESPECT for Hoisting in Warehouses, Printing, Ventilating, Running small Shops, etc.
2, 4 and 7 H. P. and upwards. Built by
SCHLEICHER, SCHUMM & CO., 3045 Chestnut Street, Philadelphia.
Boston Agency, HILL, CLARKE & CO., 36 and 38 Oliver Street.
New York City Agency, H. S. MANNING & CO., 111 Liberty Street.

CORLISS STEAM ENGINES,



MADE BY
WATTS, CAMPBELL & CO.
Passaic Machine Works,
NEWARK, N. J.
MANUFACTURERS OF THE
IMPROVED CORLISS
Compound Steam Engine,
Horizontal Beam and Vertical Direct Acting Condensing and Non-Condensing, in sizes varying from 30 to 2,000 Horse Power. ☞ Send for Circular.

LANE & BODLEY CO.
CINCINNATI, O.
Manufacturers of Wilson's Patent Free Open Double Disk
LEVER VALVE,
for Steam or Water, from 1¼" to 6". This valve has peculiar merits as a throttle valve for steam engines, and is well adapted to the use of a Sawyer's Valve, in place of the butterfly. Send for our catalogue and price list

$125. ENGINE LATHES. $125.

First-Class in Every Respect.
CALL AT
A. J. WILKINSON & CO.'S,
184 to 188 Washington Street,
BOSTON.

SECOND-HAND and NEW TOOLS FOR SALE LOW.

November List No. 1.

Pit Lathe, 31½ ft. swing, will turn a pulley as wide as 9 ft. face.
Pit Lathe, 16 ft. swing, will turn a pulley 30 inch face, with gear-cutting attachment.
Lathe, 40 in. swing, 27 ft. bed.
Lathe, 54 in. swing, 26 ft. bed.
Lathe, 100 in. swing, 18 ft. bed.
Lathe, 28 in. swing, 26 ft. bed.
Lathe, 24 in. swing, 15 ft. bed.
Lathe, 21 in. swing, 8 ft. bed.
Lathe, 19 in. swing, 6¾ ft. bed.
Engine Lathes, 4 ft. bed.
Horizontal Drilling Lathe, 24 in. swing, 19 ft. bed.
Planer, 32 in. wide, 6 ft. long.
Planer, 26 in. wide, 5 ft. long. New.
Planer, 16 in. wide, 3 ft. long. New.
Planer, 24 in. wide, 6 ft. long.
Planer, 33 in. wide, 5 ft long.
Planer. 32 in wide, 8 ft. long.
Planer, 52 in. wide, 18 ft. long.
Dimension Planer, 24 in. x 18 ft.
Upright Drill Press, 16 in. swing.
Upright Drill Press, 48 in. swing.
Suspension Drill.
Upright Boring Mill, 4 . between uprights.
Gear Cutting Machine. 24 in.
Boring Bar, 12¾ in. diam., 10 ft long, self-feeding.
Boring Bar, 9 in. diam. 8½ ft. long, self-feeding
Forcing Machine, for forcing shafts off pulleys.
Crank Planer.
Combined Punch and Shear.
Power Press.
8x12 Horizontal Engine.
Two McKenzie Cupolas, 4 ft. x 4½ inside.
No. 7 Sturtevant Blower.
Rattler, Ladles, &c., &c.
Seven Cranes.
Jig Saw.
Pattern Makers' Lathe.
Post Drills.
Pratt & Whitney Bar Iron Cutter.
Lathe, 16 x 6.

The Wood & Light Machine Co.

PATTERNS

Of Machinists' Tools are for sale at very low prices.

For Sale by

The George Place Machinery Agency,
121 Chambers and 103 Reade St.,
NEW YORK.

The "Abbe" Bolt Forging Machine,

THE PALMER POWER HAMMER,

Engine Lathes,

And General Machine Tools a Specialty. Address, for circulars and prices,

S. C. FORSAITH & CO.
Machinists and General Machine Dealers,
MANCHESTER, N. H.
Branch Office and Warerooms,
207-209 CENTRE STREET, N. Y. C.

SEND FOR PAMPHLET. THE FAR-FAMED **AMERICAN LUBRICATOR.** SEEN THOUSAND IN USE.
AMERICAN LUBRICATOR CO.
DETROIT. MICH. U.S.A.

RALPH R. OSGOOD'S BOOM DREDGE.

Adapted to all kinds of under-water excavation. Guaranteed to excavate 50 per cent. more material from hard bottom than any other machine made, all things being equal. Illustrative pamphlets, comparative strain sheets and estimates furnished on application. ☞ See AMERICAN MACHINIST of July 31, 1880. Address
RALPH R. OSGOOD, Troy, N. Y.
☞ When in New York City will be 81 Astor House.

J. A. FAY & CO. (CHICAGO STORE,)
Keep in stock a full line of **Wood-Working Machinery** of their own manufacture. (Shops, Cincinnati, O.)

Agents for and keep in stock Lathes, Planers, Drills, Steam Pumps and Supplies. J. A. FAY & CO., Chicago.

NEWELL'S PATENT Universal Grinder.

Has no equal for grinding grain or pulverizing quartz, phosphates, bone, cement, oyster shells, scraps, glue, fire clay, and other articles of similar nature. Is unrivaled in the amount of work it will do in any given time and in the economy of power used. Delivers a perfectly **GRANULATED** article. In grinding grain the meal **IS NOT HEATED.** It is compact, portable and not expensive.
Call and see the machine at work at
Foot West 19th St., New York City.
NEWELL & CHAPIN.

ALMOND DRILL CHUCK

Made of Steel throughout, equal to doing any work required of it. Runs perfectly true.
For sale by all Machinists' Supply Stores.
T. R. ALMOND,
84 Pearl Street, Brooklyn, N. Y.

EMPIRE FORGES

Improved, without Belts, Bellows, Crank Pins, Dead Centers or Back motion. Send for circular.
Empire Portable Forge Co.
COHOES, N. Y.

"VICTOR" Feed Water HEATER AND PURIFIER,

(Patent Nov. 6, 1877.)
For Heating and Purifying Water for Steam Boilers.
Wm. Allen & Sons,
WORCESTER, Mass.

The Hendey Machine Co.

WOLCOTTVILLE, CONN., U. S. A.
Manville Patent Iron Planers and Shapers.

15 in. Shapers, 24 in. Shapers, 3½ ft. x 16 in., 5 ft. x 20 in., 6 ft. x 24 in., 8 ft. x 24 in. Planers, Amateurs' Hand Planers, with chuck and centers, Hollow Steel Spindle Hand Lathes, Brass and Wire Slitters, Spring Chuck, and Common Clock Lathes. Catalogue gives many names of users of our tools.

SECOND-HAND AND NEW

Machinists' Tools.

DECEMBER 10, 1880.

One Engine Lathe, 90 in. x 20 ft. Ames. New.
One " " 42 in. x 6½ ft. Gauge, W. & W.
One " " 30 in. x 12 ft. Ames. New.
One " " 28 in. x 27 ft. For shafting. New.
One " " 24 in. x 12 ft. Ames. New.
One " " 24 in. x 10 ft. " "
Two " " 18 in. x 8 ft. Jones & Lawson, net.
One " " 15 in. x 6 ft. Good order.
One " " 11 in. x 4 ft.
One 52 in. x 36 ft. Lathe.
One Hand Lathe, 11 in. x 4½ ft. New Spencer.
Four " " 7 in. x 2½ ft. " "
One Planer, 24 in. x 5 ft.
One " 24 in. x 6 ft. Ames. New.
One " 20 in. x 5 ft. Pratt & Whitney.
One No. 3 Screw Machine. Pratt & Whitney.
Four 9 in. Stroke Shapers, New, Hewes & Phillips.
One 15 in. Stroke Hendey Shapers. New.
One 32 in. Drill. Bk. Geared.
Two 36 in. Drills Bk. Geared, Self-Feed. L. W. Pond.
Three 20 in. Drill. Prentiss, new.
One 5 Spindle Chucking & Drilling Mach. Remington.
One Gear Cutter, Gould.
One " " Whiton. New.
Three Newell Punch Presses.
Wilder Punch Press.
One No. 4 Geared. New.
One No. 6 Wilder Shear. Geared, new.
Seven Stephens' Vises. Also, Parker Vises.
Gear Cutters Miller's Gang Drills and other special Machinery.

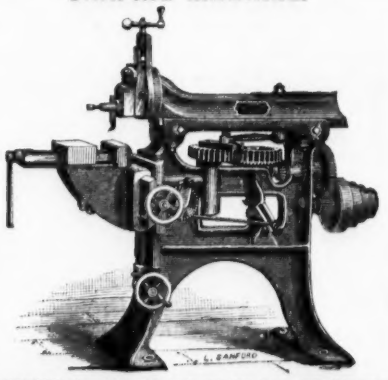
E. P. BULLARD,

14 Dey Street, New York.

General Eastern Agent for

Akron Iron Co's Patent Hot Polished
SHAFTING.

SHAPING MACHINE.



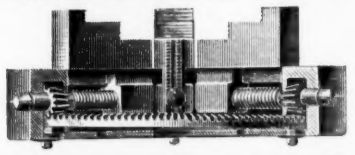
HEWES & PHILLIPS' IRON WORKS,

NEWARK, N. J.
Manufacturers of the new
Patent High Speed Allen Engine,
Planers, Lathes, Gear Cutters, Shapers, Slotters, Drill Presses,
Both double and single column, Bolt and Pipe Cutters, Keyseating Machines, Hydraulic and Sugar Estate Machinery, Shafting and Gearing, Boilers, &c. Heavy Hydraulic Oil Presses a specialty.

ENGRAVING ON WOOD

MECHANICAL WORK A SPECIALTY.
D. H. TUTTLE, No. 5 BEEKMAN ST., N.Y.

"The Sweetland Chuck."



UNIVERSAL, INDEPENDENT AND ECCENTRIC.
UNEXCELLED for ACCURACY, STRENGTH, DURABILITY AND SIMPLICITY OF CONSTRUCTION.
SWEETLAND & COMPANY,
126 Union St., New Haven, Conn.

THE
Rollstone Machine Co.

FITCHBURG, MASS.
Rotary and Stationary Bed Planers, Wardwell's Patent Saw Benches,
Waymouth Lathes,
and large number of special machines.
We also carry a large stock of Second-Hand Machinery. Send stamp for Catalogue.

TAPS & DIES · VISES · CHUCKS · TWIST DRILLS · MACHINE SCREWS · LATHES · FILES · STEEL · CUT STUDS · STUBS
TOOLS

TOOLS for Machinists, Carpenters, Amateurs, Jewellers, Model Makers, Blacksmiths, Coachmakers, etc.
Send for Catalogue, and state *what kind* of Tools you require.
TALLMAN & McFADDEN, 607 Market St., Philad'a.

Water Wheel Governor

Snow's Latest Improved.

Used by the Largest Mills.

COHOES IRON FOUNDRY & MACHINE COMP'Y
COHOES, N. Y.

DRAWING INSTRUMENTS

AND MATERIAL, PAPER, &C.
G. S. WOOLMAN,
116 Fulton Street, New York.
Fully priced and illustrated Catalogues.

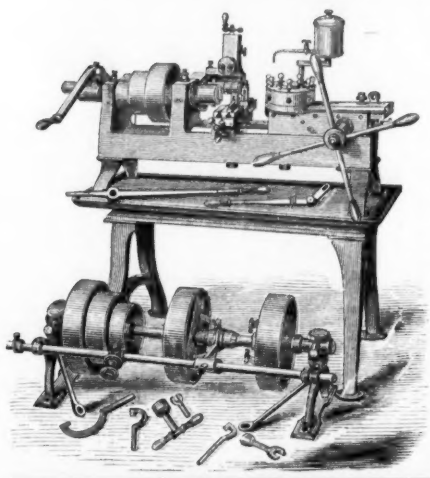
SHEPARD'S CELEBRATED
$60 SCREW CUTTING FOOT LATHE,
Foot and Power Lathes, Drill Presses, Scrolls, Circular and Band Saws, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Callipers, etc. Send for catalogue of outfits for amateurs or artisans.
H. L. SHEPARD & CO.
231, 233, 235 & 237 West Front Street,
Cincinnati, Ohio.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I.

Manufacturers of

MACHINERY AND TOOLS.



Gears Cut and Index Plates

MADE AND DRILLED TO ORDER.

Illustrated Catalogue sent per mail on application.

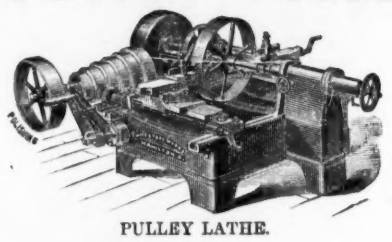
THE No. 1 SCREW MACHINE is suitable for making from bar iron all kinds of screws and studs ordinarily used in a machine shop. One man with this machine will produce as many screws as from three to five men can make on as many engine lathes, and they will be more uniform in size. Nuts can be drilled, tapped, and one side faced up, and many parts of sewing machines, cotton machinery, gas and steam fittings made on this machine, with a great saving of time and labor. Size of hole through spindle, 1¼ inches. Size of holes in revolving head, 1 1-16 inches. Length that can be milled, 6 inches.

SPECIAL PULLEY MACHINERY,

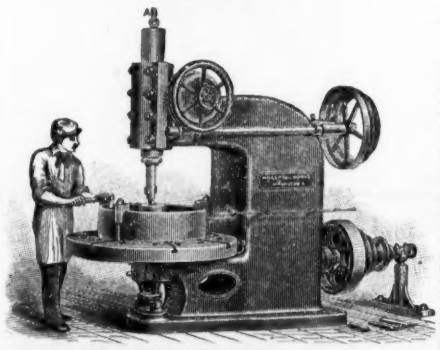
BUILT BY

NILES TOOL WORKS,

HAMILTON, OHIO.



PULLEY LATHE.

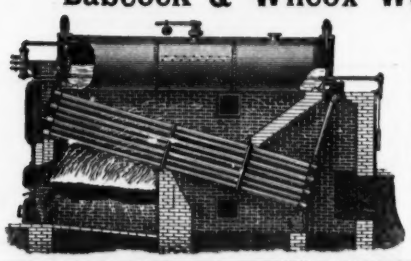


PULLEY BORER.

We refer to the following firms who are using these machines:

Speedwell Iron Works, Glasgow, Scotland.
E. Leonard & Sons, London, Ontario.
Lidgerwood Mfg. Co., New York.
Crane Bros. Mfg. Co., Chicago, Ills.
Thos. Wood, Philadelphia, Pa.
Jas. Smith Woolen Mchy. Co., Philadelphia, Pa.
Columbus Iron Works Co., Columbus, Ga.
Buckeye Engine Co., Salem, O.
A. Plamondon Mfg. Co., Chicago, Ills.
Great Western Mfg. Co., Leavenworth, Kan.
Atlas Engine Works, Indianapolis, Ind.
E. P. Allis & Co., Milwaukee, Wis.
John T. Noye & Sons, Buffalo, N. Y.
Talbott & Sons, Richmond, Va.
Fulton Foundry, San Francisco, Cal.
O. A. Pray & Co., Minneapolis, Minn.
Bradford Mill Co., Cincinnati, O.
Defiance Machine Works, Defiance, O.
Butterworth & Lowe, Grand Rapids, Mich.

Babcock & Wilcox Water-Tube Steam Boiler.



Adapted for all Purposes. Safe from Explosions.

3,191 H. P. in use by SINGER MF'G CO., New York; 3,030 H. P. by HARRISON, HAVEMEYER & CO., Philadelphia; 2,580 H. P. by DeCASTRO & DONNER SUGAR REFINING CO., Brooklyn; 3,800 H. P. by AMERICAN GRAPE SUGAR CO., Buffalo; 850 H. P. by THE JESSUP & MOORE PAPER CO., Wilmington; 720 H. P. by RARITAN WOOLEN MILLS, New Jersey; 600 H. P. by STUDEBAKER BROS. MF'G CO., South Bend, Ind., and hundreds of others in all kinds of business, from 50 H. P. to 2,000 H. P. each. Centennial Exposition Medal awarded this boiler for highest economy and efficiency on test.

Illustrated Circulars and other desired information promptly furnished.

BABCOCK & WILCOX, Engineers,
30 Courtlandt Street, New York

Emery Wheels & Grinding Machines.

THE TANITE CO.

Stroudsburg, Monroe County, Pa.

Orders may be directed to us at any of the following addresses, at each of which we carry a stock:

New York, 14 Dey St.
Chicago 152 & 154 Lake St.
St. Louis, 209 North Third St.
St. Louis, 811 to 819 North Second St.
Cincinnati, 212 West Second St.
Louisville, 427 West Main St.
Indianapolis, Cr. Maryland & Delaware Sts.
New Orleans, 26 Union St.
San Francisco, 2 & 4 California St.
Philadelphia, 11 North Sixth St.
Boston, 21 Doane St.
Portland, Oregon, 43 Front St.
London, 9 St. Andrew's St., Holborn Viaduct, E. C.
Liverpool, 42, The Temple, Dale St.
Sydney, N. S. W., 11 Pitt St.

AIR COMPRESSORS.
PRICES REDUCED. SEND FOR NEW CATALOGUE.
CLAYTON STEAM PUMP WORKS,
14 AND 16 WATER STREET, BROOKLYN, N.Y.

Iron Gears of all sizes and kinds to order. Job Gear Cutting a specialty. Facilities complete. Send for Catalogue.

Brass Gears of superior quality, in great variety, sent by mail at low prices. GEO. B. GRANT, Alden St., op. 90 Sudbury St., Boston, Mass.

COPE & MAXWELL M'F'G CO.

HAMILTON, OHIO., U. S. A.

New and Improved Patterns of

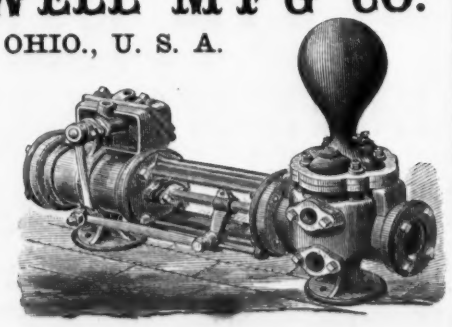
STEAM PUMPING MACHINERY,

FOR

Boiler Feeding, Water Works

and all general and special Pumping purposes.

Send for New Catalogue, illustrating every variety of Pumping Machinery.



THE PRATT & WHITNEY CO.

HARTFORD, CONN., U. S. A.

MANUFACTURERS OF

MACHINISTS' TOOLS,

GUN, AND SEWING MACHINE MACHINERY.

Renshaw Ratchet Drills,

CUSHMAN'S COMBINATION LATHE CHUCKS,

EXTERNAL AND INTERNAL CYLINDRICAL GAUGES,

Newell's Patent Planer Vise.

Send for Illustrated Catalogue and Price Lists.

THE BILLINGS & SPENCER CO.

C. E. BILLINGS, Pres't.
L. H. HOLT, Treasurer.
E. H. STOCKER, Secretary.

Trade B Mark.

HARTFORD, Conn.

MANUFACTURERS OF

SCREW PLATES AND DIES,

TAP AND REAMER WRENCHES,

Genuine Packer Ratchet Drills, Clamp, Die and Common Lathe Dogs,
Billings' Pat. Adjustable Pocket Wrenches, Barwick Pipe Wrenches,
Combination Pliers, Beach's Pat. Thread-cutting Tool,
Spencer's Pat. Recapper and Uncapper, for Shot-Gun Shells,
Billings' Pat. Drop Forged and Cold Pressed Sewing Machine Shuttles.

AND ALL DESCRIPTIONS OF

STEEL AND IRON DROP FORGINGS,

FOR

Guns, Pistols, Sewing Machines, Machinists' Tools,

And Machinery Generally.

GOLD MEDAL AWARDED, PARIS EXPOSITION, 1878.

BLISS & WILLIAMS,

PLYMOUTH, PEARL & JOHN STREETS, BROOKLYN, N. Y.

Manufacturers of all kinds of

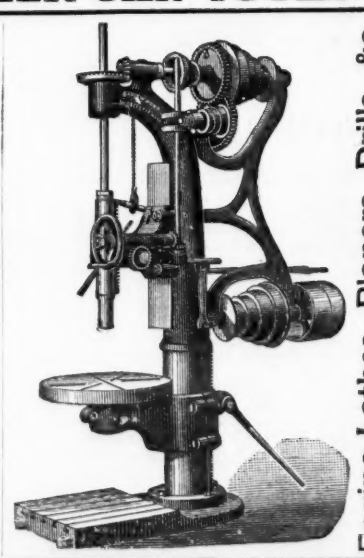
Presses, Dies and Special Machinery

FOR WORKING SHEET METALS, &c.

FRUIT AND OTHER CAN TOOLS.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

J. M. ALLEN, PRESIDENT.
W. B. FRANKLIN, VICE-PRESIDENT.
J. B. PIERCE, SECRETARY.



Engine Lathes, Planers, Drills, &c.
DAVID W. POND, Worcester, Mass.
Send for Catalogue of New Designs.

DO YOU WANT TO BECOME A TELEGRAPH OPERATOR?
Send 20 cents for BEST ILLUSTRATED INSTRUCTION BOOK published. **C. E. JONES & BRO., Cincinnati, O.**

JAMES W. SEE, Consulting Engineer,

HAMILTON, OHIO.

ROP PRESSES

PUNCHING PRESSES,

DIES AND OTHER TOOLS

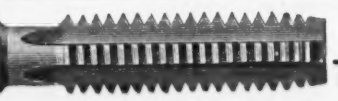
For the manufacture of all kinds of

Sheet Metal Goods, Drop Forgings, &c.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

J. M. CARPENTER
PAWTUCKET, R. I.



MANUFACTURER OF

TAPS & DIES.